Annales Mycologici

Editi in notitiam Scientiae Mycologicae Universalis

Vol. VIII	No. 5	Oktober 1910

Sydow, Mycotheca germanica Fasc. XVIII—XIX (No. 851—950).

Die genannten beiden Faszikel wurden im September 1910 ausgegeben und enthalten:

851. Marasmius Rotula (Scop.) Fr.
852. M. scorodonius Fr.
853. Irpex deformis Fr.
854. I. fusco-violaceus (Schrad.) Fr.
855. Cantharellus cinereus (Pers.) Fr.
856. Thelephora caryophyllea (Schaeff.) Fr.
857. Corticium bisporum (Schroet.) v. Höhn. et Litsch.
858. Tulasnella anceps Bres. et Syd. n. sp.
859. Clavaria albida Schaeff.
860. Pistillaria inaequalis Lasch.
861. Cyphella gibbosa Lév.
862. Uromyces Fischeri-Eduardi P. Magn.
863. U. Genistae-tinctoriae (Pers.) Wint.
864. U. scutellatus (Schrank) Lév.
865. Puccinia Arenariae (Schum.) Wint.
866. P. coronata Cda.
867. P. Drabae Rud.
868. P. Menthae Pers.
869. P. Mulgedii Syd.
870. P. Pozzii Sem.
871. P. Pringsheimiana Kleb.
872. P. Tragopogi (Pers.) Cda.
873. Phragmidium violaceum (Schultz) Wint.
874. Endophyllum Sempervivi (Alb. et Schw.) De By.
875. Coleosporium Euphrasiae (Schum.) Wint.
876. C. Melampyri (Reb.) Kleb.
877. Milesina Blechni Syd.
878. M. vogesiaca Syd. n. sp.
879—880. Melampsorella Cerastii (Pers.) Schroet.
881. Ustilago violacea (Pers.) Fuck.
882. Urocystis Agropyri (Preuß) Schroet.
883. Tuburcinia Trientalis Berk. et Br.
884. Peronospora leptosperma De Bary.
885. Microsphaera marchica P. Magn.
886. Sphaerella Adonis Sacc.
887. Didymosphaeria fenestrans (Duby) Wint.
888. Leptosphaeria multiseptata Wint.
889. Leptosphaeriopsis acuminata (Sow.) Berl.
890. Ophiobolus tenellus (Auersw.) Sacc.
891—892. Valsa ambiens (Pers.) Fr.
893. Chorostate leiphaemia (Fr.) Trav.
894. Cucurbitaria Spartii (Nees) Ces. et De Not.
895. Plowrightia ribesia (Pers.) Sacc.
896. Pleonectria berolinensis Sacc.
897. Lophodermium arundinaceum (Schrad.) var. Actinothyrium (Fuck.) Rehm.

898. Stegia fenestrata (Rob.) Rehm.
899. St. Ilicis Fr.
900. Fabraea Cerastiorum (Wallr.) Rehm.
901. Pezizella aspidiicola (Berk. et Br.) Rehm.
902. P. punctiformis (Grev.) Rehm.
903. Mollisia culmina (Sacc.) Rehm.
904. M. Phalaridis (Lib.) Rehm.
905. Dasyscypha calyciformis (Willd.) Rehm.
906. D. Caricis (Desm.) Sacc.
907. D. pulverulenta (Lib.) Sacc. nov. var. conicola Rehm.
908. Tapesia hydrophila (Karst.) Rehm.
909. Trichobelonium Kneiffii (Wallr.) Schroet.
910. Verpa bohemica (Krombh.) Schroet. var. bispora (Sor.)
911. Phyllosticta maculiformis Sacc.
912. Ph. Platanoidis Sacc.
913. Phoma samararum Desm.
914. Ph. Torilis Syd. n. sp.
915. Phomopsis oblita Sacc. n. sp.
916. Cytospora aurora Mont. et Fr.
917. C. Corni West.
918. C. Massariana Sacc.
919. C. minuta Thuem.
920. C. Ostryae Syd. n. sp.
921. Diplodia elaeagnella Tassi.
922. D. Ostryae Syd. n. sp.
923. D. rudis Desm. et Kickx.
924. Placosphaerella silvatica Sacc. n. sp.
925. Hendersonia Luzulae West.
926. Septoria Calamagrostidis (Lib.) Sacc.
927. S. Cerastii Rob. et Desm.
928. S. Gei Rob. et Desm.
929. S. Stenactis Vill n. sp.
930. Phleospora Aceris (Lib.) Sacc.
931. Discosia Artocreas (Tode) Fr.
932. Gloeosporium inconspicuum Cav.
933. Marssonia Betulae (Lib.) Sacc.
934. Septogloeum sulphureum Syd. n. sp.
935. Cylindrosporium septatum Romell.
936. Oidium Evonymi-japonici (Arc.) Sacc.
937. Haplobasidium Thalictri Eriks.
938. Ovularia sphaeroidea Sacc.
939. O. Villiana P. Magn.
940. Ramularia Anthrisci Höhn.
941. R. filaris Fres.
942. R. Spiraeae-Arunci (Sacc.) Allesch.
943. R. variabilis Fuck.
944. Coniosporium Arundinis (Cda.) Sacc.
945. Coniothecium Mollerianum Thuem.
946. Cladosporium herbarum (Pers.) Lk.
947. Sporodesmium Vogelianum Syd. n. sp.
948. Cercosporella Magnusiana Allesch.
949. Graphiothecium parasiticum (Desm.) Sacc.
950. Illosporium Diedickeanum Sacc.

858. **Tulasnella anceps** Bres. et Syd. nov. spec.

E pustuliformi mox confluens et late effusa, tenuis, submembranacea, vix gelatinosa, in sicco subfurfuracea, ex roseolo alba, margine similari; hymenium sublaeve in bene evolutis; sporae hyalinae, oblongae, subamygdaliformes, 8—13 ⩽ 5—7 μ, apice vel dorso germinantes et sporam secundariam gignentes; basidia clavato-capitata, 13—18 ⩽ 6—8 μ, 2—4-sterigmatica; sterigmata primitus obverse obovata, parva, dein elongato-cuspidata. 8—10 ⩽ 2—$2^1/_2$ μ; hyphae subhymeniales 2—7 μ crassae, septatae, enodulosae.

Hab. in frondibus Pteridis aquilinae quas enecat, pr. Graal, Mecklenburg, 8. 1908, leg. H. Sydow. — Species haec receptaculo submembranaceo vix gelatinoso ad *Corticia* vergit, sed structura omnino *Tulasnellae.*

Der merkwürdige Pilz befällt die lebenden Pflanzen, die in kurzer Zeit vollständig zugrunde gerichtet werden. Er wurde nur an einer einzigen Stelle in der Rostocker Heide bei Graal beobachtet, wo in einem ausgedehnten dichten Pteris-Bestande ein Komplex im Umfange von zirka 30 Quadratmetern durch den Pilz vernichtet wurde. Die befallenen Pflanzen erwecken den Anschein, als ob sie mit Kalk oder Mehl bestreut wären.

870. **Puccinia Pozzii** Semadeni.

Der seltene Pilz war bisher nur aus der Schweiz und Tirol von je einem Standorte bekannt. Sein Auffinden innerhalb des Deutschen Reiches ist daher bemerkenswert. Wir entwerfen nach den deutschen Exemplaren folgende Beschreibung:

Soris teleutosporiferis plerumque petiolicolis, rarius etiam foliicolis et tunc tantum nervos sequentibus, minutis, sed in greges plus minusve elongatos usque 1 cm longos dense dispositis tandemque confluentibus, primo epidermide tectis, dein nudis, pulverulentis, obscure brunneis; teleutosporis irregularibus, plerumque oblongis vel irregulariter oblongis, utrinque rotundatis vel basi attenuatis, apice papillula minuta supra porum praeditis, medio plerumque leniter constrictis, levibus, dilute brunneis, 25—42 ⩽ 14—25; pedicello hyalino, breviusculo, deciduo, saepius oblique inserto.

Hab. ad nervos foliorum et petiolos Chaerophylli hirsuti var. glabrati in regione montis Hohneck Vogesorum, 7. 1910.

877. **Milesina Blechni** Syd. nov. nom.

Dieser in den Annal. Mycol. I, 1903, p. 537 unter dem Namen *Melampsorella Blechni* Syd. beschriebene Pilz gehört zu der kürzlich von P. Magnus aufgestellten Gattung *Milesina* (cfr. Berichte d. Deutsch. botan. Gesellsch. vol. XXVII, 1909, p. 325) und muß demnach wie oben angegeben bezeichnet werden. An solchen Lokalitäten, wo die pilzbesetzten Blätter dem feuchten Erdboden dicht anliegen, läßt sich beobachten, daß die Uredosporen in weißen Ranken ausgestoßen werden. Selbst an den hier verteilten getrockneten Exemplaren lassen sich hier und dort diese Ranken noch deutlich erkennen.

878. **Milesina vogesiaca** Syd. nov. spec.

Soris uredosporiferis hypophyllis, plus minusve dense sparsis, subepidermicis, minutis, rotundatis, pustuliformibus, primo flavidis, dein brunneolis, tandem centro poro apertis et uredosporas in cirros albidos expellentibus; uredosporis ellipsoideis, ovatis vel oblongis, levibus, hyalinis,

20—40 ⩽ 15—22, raro usque 50 μ longis, poris germinationis nullis; teleutosporis paucis tantum visis et aegre perspiciendis, pluricellularibus ut videtur et intracellularibus.

Hab. in frondibus Aspidii lobati prope Fischboedle regionis montis Hohneck Vogesorum, 7. 1910.

Die vorliegenden Exemplare enthalten in prächtigster Entwicklung die Uredoform des interessanten Pilzes. Nur wenige anscheinend noch nicht völlig entwickelte Teleutosporen konnten beobachtet werden, so daß deren obige Beschreibung später nach entsprechendem Materiale zu ergänzen ist. Die neue Art unterscheidet sich in der Uredoform von den übrigen Spezies der Gattung *Milesina* sofort durch die völlig glatten Uredosporen.

883. **Tuburcinia Trientalis** Berk. et Br.

Die hier verteilten märkischen Exemplare verdienen besonderes Interesse, da der Pilz aus der Mark Brandenburg bisher nicht bekannt war.

903. **Mollisia culmina** (Sacc.) Rehm in litt.

Zufolge Rehm's Mitteilung ist *Mollisia cinerea* c *culmina* Sacc. in Syll. VIII, p. 336 als eigene Art aufzufassen und wie oben zu benennen. Synonym hiermit ist *Mollisia minutella* (Sacc.) Rehm fa. *culmina* Rehm in Ascom. Exs. No. 1762. Außerdem wurde der Pilz noch in Sydow Myc. marchica No. 1462 unter *M. cinerea* ausgegeben.

907. **Dasyscypha pulverulenta** (Lib.) Sacc. nov. var. **conicola** Rehm in litt.

Außer dem Vorkommen des Pilzes auf den Zapfen statt auf Kiefernadeln liegt der eigentliche Unterschied gegenüber der Hauptart nur in den nicht harzigen Haaren, so daß der Pilz wohl kaum als besondere Art von *D. pulverulenta* abzutrennen sein dürfte.

914. **Phoma Torilis** Syd. nov. spec.

Pycnidiis sparsis, minutis, globoso-lenticularibus, atris, 200—350 μ diam., poro pertusis; sporulis ovato-oblongis, continuis, hyalinis, biguttulatis, 5—6 ⩽ 2 μ.

Hab. in caulibus siccis Torilis Anthrisci, Tiefensee pr. Werneuchen, 30. 5. 1909, leg. H. Sydow.

915. **Phomopsis oblita** Sacc. nov. spec.

Die Diagnose dieses Pilzes ist auf p. 343 dieses Jahrgangs veröffentlicht.

920. **Cytospora Ostryae** Syd. nov. spec.

Stromatibus sparsis vel gregariis, peridermio leniter pustulatim elevato tectis, disco minuto, nigro erumpentibus, intus atro-olivaceis, $^1/_2$—1 mm latis, 4—8-locularibus; sporulis allantoideis, 5—7 ⩽ 1—$1^1/_2$ μ rectis vel leniter curvulis, hyalinis.

Hab. in ramis Ostryae virginicae, Tamsel, 10. 11. 1909, leg. P. Vogel.

922. **Diplodia Ostryae** Syd. nov. spec.

Pycnidiis gregariis, subcutaneo-erumpentibus, subglobosis, atris, ca. 250—300 μ diam; sporulis oblongis, utrinque rotundatis, medio 1-septatis non vel vix constrictis, fusco-brunneis, 20—23 ⩒ 8—10 μ; basidiis brevibus, hyalinis.

Hab. in ramis Ostryae virginicae, Tamsel, 10. 11. 1909, leg. P.Vogel.

924. **Placosphaerella silvatica** Sacc. nov. spec.

Die Diagnose der neuen Art ist auf p. 344 dieses Jahrgangs publiziert.

928. **Septoria Gei** Rob. et Desm.

Die Sporen dieser Art werden in Saccardo's Sylloge III, p. 510 als einzellig angegeben, sind jedoch an den vorliegenden Exemplaren deutlich mehrfach (bis 10-) septiert und bis 50 μ lang.

929. **Septoria Stenactis** Vill nov. spec. in litt.

Maculis amphigenis, orbicularibus vel suborbicularibus, minutis, 2—3 mm diam., arescendo albidis vel griseis, margine purpureo cinctis; peritheciis epiphyllis, singulis vel paucis in quaque macula, atris, exiguis; sporulis filiformibus, rectis vel flexuosis, guttulatis vel spurie septatis, hyalinis, 35—40 ⩒ 1 μ.

Hab. in foliis inferioribus Stenactis annuae, pr. Gerolzhofen Franconiae infer., Bavaria, 9. 1909, leg. A. Vill.

934. **Septogloeum sulphureum** Syd. nov. spec.

Acervulis sparsis, innato-erumpentibus, 1 mm diam., rotundatis, sulphureis, peridermii laciniis cinctis; conidiis falcatis, utrinque acutis, 3—5-septatis, hyalinis vel flavo-hyalinis, 50—70 ⩒ 5 μ.

Hab. in ramis Abietis pectinatae in silva pr. Schiessrotried regionis montis Hohneck Vogesorum, 7. 1910.

947. **Sporodesmium Vogelianum** Syd. nov. spec.

Caespitulis sub epidermide sitis eamque elevantibus et tandem longitudinaliter disrumpentibus, ca. $^1/_2$—1 mm longis, atris, denique subsuperficialibus et confluendo majoribus; conidiis ovatis, ovato-oblongis usque clavulatis, 3—4-septatis, ad omnia septa constrictis, cellulis 2—3 septo longitudinali divisis, flavo-brunneis, 20—38 ⩒ 13—19 μ, pedicello hyalino continuo vel 1—2-septato crasso usque 35 μ longo suffultis.

Hab. in ramis emortuis junioribus et pedunculis Celtidis occidentalis, Tamsel, 2. 6. 1910, leg. P. Vogel.

An account of Danish Freshwater-Phycomycetes, with biological and systematical remarks.

By Henning E. Petersen.

Introduction.

The following paper is a somewhat abreviated translation of my paper: „Studies on submerse Freshwater-Phycomycetes, a contribution to the knowledge of the biology and systematic of the submerse Phycomycetes together with their distribution in Denmark", published in Danish, with a short résumé in English, in „Botanisk Tidsskrift" Bd. 29, H. 4, 1909.

The paper is divided into 3 parts:

I. Remarks on the systematic of the submerse Phycomycetes. The chief contents of this part is a polemic against the view which establishes a genetic connection between the *Monadineae* and the *Chytridineae*, and an attempt at a natural systematization of the *Chytridineae* based upon de Bary's hypothesis of reduction. The views given in this treatment differ in several particulars from those of Atkinson lately published here in „Annales mycologici". But as the chief aim of this paper is to give a translation of my Danish paper and not a revision, in which I should take the work of Atkinson into consideration, I thought myself entitled to translate this part without alterations.

II. The second part deals with the occurrence of the submerse Phycomycetes in nature, their biological circumstances, as I have observed them in Denmark. I take it for granted that investigators of Phycomycetes are acquainted with the occurrence of these fungi in nature, but yet I believe that my essay in several points will bring something new to light. At any rate there does not exist a detailed essay on this question in literature. Though it is only nature in Denmark I have been treating of here, I hope this paper will be of some use.

III. The third part of this paper is a list (cataloque raisonnée) of the submerse Phycomycetes in Denmark, with critical remarks. The Danish essay is more elaborate containing descriptions of the different families, genera and species, as it was thought that this would make the paper more useful in my country. In this paper everything superfluous is removed, but as I have formed a partly new system, especially with respect to the *Chytridineae*, I cannot help trenching several times on the diagnoses of families, etc.

I have not investigated all parts of Denmark. The collections are mostly derived from the north-eastern part of Sealand and the from central Jutland, and in most cases they date from the years 1900—1903. My investigations of the first mentioned district being very exact, I have been able to prove that the fungi in question are very common and often constant companions of the societies to which their hosts and substrata belong.

General part.

I. Remarks on the affinities of the submerse Phycomycetes.

The submerse Phycomycetes may be divided into six groups: 1. *Saprolegniineae*, 2. *Peronosporineae* (fam. Pythiaceae), 3. *Monoblepharidineae*, 4. *Gonapodyineae*, 5. *Blastocladiineae*, 6. *Chytridineae*.

In my opinion the first of these groups is subdivided into three families: *Saprolegniaceae*, *Rhipidiaceae* and *Pythiomorphaceae*. The last mentioned is for the first time presented here, the genus *Pythiomorpha* having never been described before. *Pythiaceae*, *Gonapodyineae* and *Blastocladiineae* comprise each but one genus, viz: *Pythium*, *Gonapodya* and *Blastocladia*. The *Monoblepharidineae* ought to be divided into three families named after *Monoblepharis*, *Diblepharis*, and *Myrioblepharis* respectively. All these groups are distinctly separated from each other without intermediate forms. The sixth group: The *Chytridineae*, consists of several separate groups, whose mutual relationships are still obscure, and whose relation to the rest of Phycomycetes as well as to other groups of plants has given rise to much speculation.

In my opinion the *Chytridineae* may correctly be derived from the more highly organized Phycomycetes or groups of Algae, which are closely related to these, a view already advanced by de Bary and Sachs in their time. The attempts which have been made to show, that the *Chytridineae* entirely or partly must be regarded as Archimycetes are no doubt founded on a wrong apprehension of the nature of the *Chytridineae*.

The starting point not being this hypothesis of reduction, it is, in my opinion, impossible to form a correct system of the *Chytridineae*. I shall try to prove this view.

The great resemblance between the Phycomycetes, for instance, the *Saprolegniineae* and the *Chytridineae* on one side, and certain groups of Algae such as *Siphoneae* and *Protococcaceae* on the other, has early given rise to the idea that the Phycomycetes necessarily must be derived from these Algae. The Phycomycetes were to be considered as forms without chlorophyll descending from Algae. Regarding the *Chytridineae* this idea appears in two ways: partly, all the *Chytridineae* were supposed to descend from the highly organized Phycomycetes, partly, there might be several origins, more especially as certain groups of Algae, among which there exist more or less reduced forms of endophytic Algae (for instance Protococcaceae with *Chlorochytrium*, etc.) had in the course of time become the seat of development

for certain *Chytridineae*. The inconsiderable size and often slight differentiation, which distinguish the *Chytridineae* are to be explained as the result of life under conditions, characterized by slight nutrition-matter. The organisms which descend from the more highly organized ones, have by degrees in some manner or other, become adapted to exist in small host-cells and on a scanty supply of food, and have thus become smaller and smaller. Perhaps the development of those, which descend from Algae, which beforehand were but slight differentiated, has taken new forms, for instance, by the formation of rhizoids. Possibly certain forms of Algae have been reduced in some manner or other. This theory is most attractive, but it is undeniably a hypothesis, and not even a well-founded hypothesis. J. Sachs and de Bary were the first to advance and defende these ideas of reduction. Among later investigators Zopf, Brefeld, and Lagerheim appear to be adherents of them.

A Fischer, in his well known work in Rabenhorst's Kryptogamenflora, assumes that the *Chytridineae* descend from the *Monadinae*, and that the less differentiated of these fungi are closely related to these organisms. The higher stages of development of the other *Chytridineae* are the result of a development from something lower to something higher, and he traces this series of development right up to the group of highly developed Phycomycetes.

During the last few years Dangeard and Vuillemin have been discussing these problems mostly in favour of the Monadine-hypothesis. Dangeard is an adherent of the view that it is necessary to give up the idea of a direct relationship between the separate species if the Phycomycetes are to be related to the Algae. Evidently several groups of Algae would then have contributed to the formation of these fungi, and their homogeneous character would then scarcely be so distinct as it in reality is. The *Chytridineae* are to him as to Fischer, Monadinae, which have changed their mode of living. The common features existing among the above-named groups of Algae and the Phycomycetes, are in his opininion due to the fact that these groups have had common ancestors. In many respects Vuillemin defends the same idea as Dangeard, but his view on the older hypothesis of reduction is not so radical as Dangeard's.

He makes a marked distinction between the *Chytridineae* with zoospores with single flagellum and those with two flagella, an idea which has been put forward before him by Lotsy, and which in my opinion is correct. He is of the opinion that the first mentioned may be derived from the *Monadinae*, while he is more reserved with respect to the derivation of the forms with two flagellated zoospores. So far as I can understand him, he derives this group of *Chytridineae* and the other submerse Phycomycetes, with the exception of the *Monoblepharidineae*, from the *Flagellatae*, with the Algae as connecting forms in conformity to the classical hypothesis. It is not wise to attach too great importance to

the number of flagella, but with respect to the *Chytridineae* the matter stands thus — the classification, which is founded on difference as to the number of the flagella in the zoospores, is not in contradiction to the morphological characters; it is on the contrary rather confirmed by these. On the other hand to connect the *Monadinae* with the uniflagellated *Chytridineae*, as Vuillemin does and upon the whole to indicate a great distinction between the two groups of *Chytridineae* appears to me to be rather absurd. It is impossible here to enter into details as to the characters of the *Monadinae*, but I shall briefly give a survey, mostly relying on the views of Délage and Hérouard, as well as of Zopf, and for the rest referring to the following. The *Monadinae* are organisms, which seem to be on the border line between animals and plants; they are destitute of Chlorophyll, and at a certain stage of development they exhibit a more or less amöeboid body, producing pseudopodia; certain forms form zoospores. Délage and Hérouard place them among the Rhizopods. Zopf calls them „Pilzthiere", but they show no doubt signs of relationship with the Myxomycetes. They appear in many different forms, some free-living, settling on their substrata, some hemiendophytic or endophytic parasites. As to their shape, their occurrence and formation of resting-spores, the last mentioned have much in common with the *Chytridineae*, and most probably this fact has given rise to the theory, that these two groups are related, both having a certain resemblance to the lowest organized *Chytridineae*, the *Olpidiaceae*.

With special reference to the ideas of Dangeard and Fischer, I shall in a few words make a comparison between the two groups, the *Chytridineae* and the *Monadinae*.

In both cases we find a zoospore, which either develops a zoosporangium, or becomes a resting-spore, but the nature of this zoospore as well as of the sporangia differ very much in the two groups.

As to the *Monadinae*, the flagellum may be looked upon as a prolongation of the body of the zoospore, while this is not the case with the zoospores in the *Chytridineae*. The manner in which the zoospore of the endophytic forms penetrate into the host-cell also differs in the two groups, and I attach great systematical importance to this difference. In the *Monadinae* the zoospore appears to dissolve the membrane and then to make its way in toto into the host-cell. As to the *Chytridineae*, where such a penetration takes place, it leaves a membrane „Cystenhaut", which for some time remains outside the membrane of the host-cell, while the the zoospore perforates the membrane. This Cystenhaut is in my opinion not only peculiar to the *Chytridineae* in question, but is a character, which unites all the *Chytridineae*, and connects these with the higher Phycomycetes, and is of such a nature that it cannot be regarded as a primitive phenomenon but rather implies a relation-

ship between the *Chytridineae* and more highly organized Phycomycetes. The zoospore of the *Achlya*, on leaving off the movements, is surrounded by a membrane, and then grows out as a hypha, from which the mycelium is developed, but the zoospore is plainly distinguishable for some time. In certain rhizoid-bearing *Chytridineae* the zoospore is retained during a longer period than in the *Achlya*, the zoospore growing into a sporangium. The zoospore is of a greater importance here than in the former, but yet the two types form a connected whole.

In the *Chytridineae*, which produce endophytic or semiendophytic sporangia, the membranated zoospore on having come to rest outside the host-cell is not able to penetrate in toto. It forwards a germination-thread, while the zoospore is left behind, either as an empty membrane or as an outer part of the zoosporangium. In other words, the group of *Chytridineae* tends to retain the membranated zoospores as long as possible, a fact, which in my opinion can only be looked upon as being the result of their derivation from membranated ancestors, consequently not from the Monadinae which during the greater part of their life are naked, and which point to a reduction of a membranated mycelium, descending from a zoospore.

The fact that the zoospore-membrane, for instance in the *Lagenidium* and the *Diplophlyctis* is retained for such a long time after its being of no use, is in my opinion a proof of the relationship between these and the other *Chytridineae*, which keep the zoospore for a very long time[1]). Whatever the forms may be, from which the forms with Cystenhaut may be derived, they are certainly not related to the *Monadinae*. The zoospore of the *Monadinae* is both before and after it has penetrated, amöeboid. Besides the body in all forms of the Monadinae is naked in the stage of nutrition, and forms Pseudopodia. With regard to the zoospores of the Phycomycetes, they are, especially in the higher forms, able to change form, but only during a very short period, but they can by no means be characterized as amöeboid. These two groups seem also to differ with respect to the nature of the membrane in the zoo-and resting sporangia, yet I do not suppose there exist any exact chemical investigations regarding this point. With respect to the coming out of the zoospores, even the most primitive forms of the *Chytridineae* betray their relationship with the more highly organized Phycomycetes by the formation of channels for the zoospores, a sort of mycelium which cannot be traced in the Monadinae, the character of their

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[1]) The genus *Eurychasma* takes up an interesting intermediate stage between the higher Phycomycetes and the other *Chytridineae*. After a short movement, the zoosporangium passes into a membranated resting-stage, which corresponds to the first resting-stage in the *Achlya*, and which assuredly has risen through the derivation from more highly-organized forms. The resting period corresponds to the stage of Cystenhaut of the other *Chytridineae*.

Pseudopodia differing from all formations of mycelium and rhizoids. With regard to sexual propagation, the *Chytridineae* differ very much from the Monadinae, in so far as these do not produce sexual cells. I do not see any reason for connecting the *Chytridineae* with the Monadinae. I do not agree with Vuillemin who attaches great importance to the zoospore stage and even takes it as a starting point. It is much simpler to take the mycelium stage as a starting point.

Is the gap between the single and two flagellated *Chytridineae* really so great, that it is necessary, as Vuillemin does to assume two separate series of evolution? In order to clear up this question it is necessary to give a résumé of the forms and groups of the *Chytridineae.*

The *Chytridineae* comprise two morphological main-groups, viz: 1. the group of the *Synchytrium,* where the zoospore on germination forms a sorus and, 2. the group, where nothing similar takes place. Within both groups genera with single- and two-flagellated zoospores are found.

The morphological differences within the *Synchytrium* group are not so obvious that we need assume any different ancestral origin for the single- or the two-flagellated genera; it is just possible that it will be quite natural to derive the single-flagellated zoospore from the two-flagellated ones by reduction of the one flagellum, a phenomenon, which is often seen elsewhere. Upon the whole the *Synchytrium* group ought in its entirety to be opposed to the other forms; but only so far that it is possible to assume related ancestors.

The question is quite different with regard to the other *Chytridineae.* Here it is very easy to point out great differences between the forms with single- and two-flagellated zoospores[1]), differences which are of great importance, even if many homogeneous forms prove to have a different number of flagella. Yet they are not incompatible; on the contrary, many things point to the fact, that these groups of *Chytridineae* have had closely related ancestors.

If we do not consider all the details, we see that the genera of the groups are mainly to be referred to 3 types 1. the *Olpidium*-Type, which is devoid of rhizoids (and where we find the uniflagellated as well as the two-flagellated zoospores). 2. The *Lagenidium*-Type where the body of the fungus is to be looked upon as a sort of mycelium without rhizoids (with two-flagellated zoospores). 3. The *Rhizidium-Cladochytrium*-Type, with many sub-types (uniflagellated zoospores), the rhizoids of which are very slender and apparently often destitute of membrane. These three morphological types are not so different in morphological respect that it is impossible to unite them. The *Olpidium*-Type is easily connected with the

[1]) In the following treatment I do not take the *Ancylistes* into consideration, which I only look upon as a specially developed *Lagenidium*, and which I place in a separate group.

Lagenidium-Type, for instance through the reduced *Myzocytium* forms and with the *Rhizidium*-Type by the *Entophlyctis heliomorpha* as an intermediate form. The relationship between the *Lagenidium*-Type and the *Rhizidium*-Type gives much more trouble by reason of the rhizoids. In my opinion we have in these a special form of adjustment for mycelium, in many cases, for instance in the *Siphonaria*, they are membranated and myceliated to a certain extent.

Zygorhizidium Willei, which has been described by Loewenthal (1904), proves most clearly that the *Lagenidium* and *Rhizidium*-Type somehow or other are related to each other. Here the rhizoids appear very distinctly, but the zoosporangium produces myceliated fertilizing-hyphae.

Thus per se it is not necessary from a purely morphological point of view to make a marked distinction between the single- and two-flagellated series.

The two series are further alike as regards to the protoplasmatic contents of refracting, fatty substances[1]). It is very easy to distinguish the *Chytridineae* from other organisms (especially the *Monadinae*) by the peculiar character of their protoplasm. This resemblance between the two series is so obvious that it almost excludes every theory of a heterogeneous derivation.

On the other hand the membrane seems to differ within the two groups, all the forms of the two-flagellated series gives reaction for the cellulose, while only traces of this substance are found in a few (endophytic) forms within the uniflagellated series in a more advanced stage. Yet we cannot rely upon our present knowledge in this respect. It is probable, that an endophytic life is particularly favourable to the development of the cellulose, while an ectophytic life appears to be favourable to substances, that make the membranes firmer and more capable of resistance. Yet the ectophytic forms may possibly have a trace of cellulose in their membrane. However, I do not believe, this possible difference between the two series could be of any importance as a proof against the hypothesis which is proposed here. By deriving the first series from the *Saprolegniineae* with cellulose in the membranes, and the other from the *Monoblepharidineae* without cellulose in their membranes, everything is settled satisfactorily. If the origin of the two series differed to such a degree as Vuillemin assumes, the contrasts between these must necessarily be greater, than they really are.

Taking the idea of Vuillemin as a starting-point and assuming, that all forms with two-flagellated zoospores, in conformity to the classical hypothesis, descend from Algae or more highly organized Phycomycetes, and on the other hand that all forms with single-flagellated zoospores have sprung from primitive forms, perhaps from the Flagellatae (at any

[1]) Most probably all genera of the *Synchytrium* group possess this character.

rate not from the Monadinae), we observe the peculiarity that the most primitive forms in one of the groups, certain *Olpidium*-shaped forms, resemble in morphological respect the final stage of the other group, certain other *Olpidium*-shaped forms. This peculiarity may be accidental, and I do not insist upon it. But my disbelief in Vuillemin's view is more particularly based on the peculiarity that one of the primitively formed representatives of the uniflagellated series, is with regard to sexual reproduction on the same level, as the inferior ones within the two-flagellated series *(Diplophysa Schenkiana, Olpidiopsis)*. It cannot be denied, that *Diplophysa* may be derived from *Olpidiopsis* through reduction of the one flagellum, but yet I am sceptical on this point. Firstly, sexual reproduction is not unknown elsewhere within the uniflagellated series (for instance *Zygorhizidium*, *Siphonaria?*, *Polyphagus*), and secondly, the flagella being really reduced within the group of the *Chytridineae*, it would no doubt have been noticed in the transitional forms somewhere in the series.

The congruity which, as proved in the foregoing, prevails between the two series, a congruity which extends to the most reduced forms, probably does away with the hypothesis that we have to deal with two heterogeneous, not related series. If we acknowledge that the two flagellated series of *Chytridineae* may be derived from higher Phycomycetes or closely related Algae, there is no alternative but to go the whole length and assume that the uniflagellated series, the primitive forms of which are consistent with the most reduced forms of the two-flagellated one, also descends from the higher Phycomycetes or from Algae which are related to these in conformity with the hypothesis of reduction. The most primitive forms of each series may be looked upon as the closing results of a phylogenetic process, which in morphological respect is retrogressive, closing results within two series, whose ancestors are closely related, thus giving these series a pronounced common stamp.

The view of Vuillemin as to the two separate groups is in my opinion best maintained in this manner.

In all probability the generally assumed connection between *Lagenidium* and *Pythium* is correct. Hence it follows that the *Pythiaceae* in accordance with the classical hypothesis of reduction may be looked upon as the ancestors of the *Lagenidiaceae*. It is difficult to decide from which family the uniflagellated series descends. Probably from the *Monoblepharidineae*, but it is just possible that it descends from certain Algae, without any intermediate stage of myceliated Phycomycetes. If so, the ancestors of the two families have been closely related. There exist, I am sure, no theories as to the origin of the *Synchytridineae*; most probably here too we have to do with reduced forms.

In the system I adopt here within the group of the *Chytridineae* I distinguish between 4 groups: *Synchytridineae*, *Lagenidineae*, and the uniflagellated

series which I designate *Euchytridiineae* and *Ancylistineae*. Certainly it is not necessary to separate the last group, the *Ancylistineae* being closely related to the *Lagenidium*, but I believe that this group in phylogenetic respect is more closely connected with the *Pythiaceae* than with the *Lagenidiaceae* and may be classed with this family, rather than be derived from it.

The *Lagenidium*-group shows very plainly a transition between the *Olpidium*-shaped species and the higher forms. For example it is a matter of fact that the *Myzocytium* may occur in the shape of an *Olpidium*. Yet this example is just a case in point, different circumstances causing us to believe that the *Myzocytium* differs from *Olpidium* in that the zoospore comes out in a vesicle in the first mentioned and not in the last mentioned. It is much more probable that a form like „*Sirolpidium*“[1]), in which the zoospores do not emerge in a vesicle, has given offspring of the *Olpidium*-shaped forms *(Olpidiopsis)* in the two-flagellated group. In the *Sirolpidium*, the zoospore grows into a sort of mycelium, which is divided into *Olpidium*-shaped sporangia. The above-named differences, with regard to the occurrence of a vesicle, might give rise to the objection that the contrasts first touched upon with regard to the escaping of the zoospore do not suggest great unity within the group of the *Lagenidium*. Quite so, a certain contrast does exist here, but not greater than we are justified in imagining that we have two closely related families before us. Most probably the difference between the *Lagenidium*-group and the *Rhizidium (Cladochytrium)* group is greater than the difference between the two above-named families of the *Lagenidium*-group. Regarding the question from a phylogenetic point of view, we must admit that most likely the ancestors of the two families have been more closely related to each other than to the ancestors of the *Rhizidium*-group.

There is no obvious transition between the *Olpidium*-shaped forms and the more highly organized ones within the group with uniflagellated zoospores, but we can easily understand this transition by assuming that the rhizoid-bearing endophytic forms by degrees have lost the power of forming rhizoids. Most likely such intermediate forms are indicated in forms as *Entophlyctis heliomorpha*, and the form which Sorokine[2]) has described as *Rhizidium tetrasporum*.

The system which I have adopted here, differs in several points, especially with regard to the *Chytridineae*, from the systems previously used. However, I shall not here enter into details with regard to these differences; I refer here to the special part.

The new species described in this paper are the following:

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[1]) Cf. my paper 1905, p. 478.

[2]) Aperçu systématique des Chyt. récoltées en Russie et dans l'Asie centrale Archives botan. du Nord de la France; Lille 1884—87, p. 33.

Saprolegnia semidioica.
Saprolegnia paradoxa.
Achlya decorata.
Aphanomyces coniger.
Pythiomorpha gonapodyides.
Pythium Daphnidarum.
Pythium undulatum.
Myzocytium irregulare.
Olpidiopsis echinata.
Phlyctochytrium stellatum.
Rhizophidium septocarpoides.
Pleotrachelus Wildemani.

Phycomycetes submersae.

Macro-Oomycetes.

1. **Saprolegniineae.**
   Fam. *Saprolegniaceae* (Saprolegnia, Leptolegnia, Aphanomyces, Aplanes, Traustotheka, [Dictyuchus]).
   Fam. *Leptomitaceae* (Leptomitus, Apodachlya, Rhipidium, Sapromyces, Araiospora).
   Fam. *Pythiomorphaceae* (Pythiomorpha).
2. **Peronosporineae.**
   Fam. *Peronosporaceae* (Pythium).
3. **Gonapodyineae.**
   Fam. *Gonapodyaceae* (Gonapodya).
4. **Blastocladiineae.**
   Fam. *Blastocladiaceae* (Blastocladia).
5. **Monoblepharidineae.**
   Fam. *Monoblepharidaceae* (Monoblepharis). (Fam. *Diblepharidaceae*, *Myrioblepharidaceae*).

Micro-Oomycetes vel Micro-Zygomycetes: Chytridineae.

1. **Lagenidiineae:** with two-flagellated zoospores.
   Fam. *Lagenidiaceae* (Lagenidium, Myzocytium).
   Fam. *Sirolpidiaceae* (Sirolpidium); marine fam.
   Fam. *Pontismaceae* (Pontisma), mar. fam.
   Fam. *Pseudolpidiaceae* (Pseudolpidium, Olpidiopsis). (Bicilium: marine gen.[1]): Bicilium Andréei = Pleotrachelus Andréei).
2. **Ancylistineae.**
   Fam. *Ancylistaceae* (Ancylistes).
3. **Euchytridineae:** with uniflagellated zoospores.
   Fam. *Cladochytriaceae*: several sporange-origins, which are connected with each other with rhizoids arising from many points (Cladochytrium [Catenaria]).
   Fam. *Chytridiaceae* (Chytridium); mycelium-shaped rhizoids with resting-spores which are apart from the zoosporangia.

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[1]) *Bicilium* nov. gen. I give this name to Olpidium-shaped and Pleotrachelus-shaped marine forms with two-flagellated zoospores.

Fam. *Rhizophlyctaceae*: rhizoids arising from several points or from a single one (Polyphagus, Rhizophlyctis, [Sporophlyctis] Entophlyctis).

Fam. *Rhizidiaceae.* Rhizoids arising from a single point or from a subsporangial vesicle.

Subf. Rhizidieae ([Rhizidium A. Braun]).

Subf. Siphonarieae (Obelidium, Siphonaria).

Subf. Diplophlycteae (Diplophlyctis).

Subf. Rhizoclosmatieae (Rhizoclosmatium, Asterophlyctis).

Subf. Phlyctochytrieae ([Rhizidiomyces], Phlyctochytrium, [Zygorhizidium] a. o.).

Subf. Rhizophidieae (Rhizophidium, [Septocarpus]).

Fam. *Eurychasmaceae*; marine fam.

Fam. Olpidiaceae: neither Mycelium nor rhizoids. (Diplophysa, Ectrogella, Pleotrachelus, Olpidium (Oligostomum: marine genus[1]) a. o.).

4. **Synchytridineae.**

Fam. *Synchytriaceae* (Micromyces?).

Fam. *Woroninaceae.*

II. Remarks on the occurrence and biological circumstances of the submerse Phycomycetes; their distribution in Denmark.

A. Occurrence and biological circumstances.

I. *Macro-Oomycetes.*

The submerse species of this group occur in Denmark mainly in two categories, viz: as saprophytes upon dead animals and parts of plants, and as parasites upon certain crustaceans. Parasitism on fishes, which has been observed for instance in England, Scotland, and Switzerland scarcely takes place in this country under natural conditions.

With the exception of the parasites on Plankton-crustaceans, which are only found in our large lakes and at a certain distance from the shore, we usual find these forms in ditches, ponds and small lakes, and on the shore of large lakes, where the water is comparatively quiet. Upon the whole it is principally on the shores of these localities, that these fungi live and thrive. Hither the substratum is blown or washed, here it falls down into the water, and here it may rest in peace and at a conveniently short distance from the surface, which is necessary for these fungi. Many of these substrata would in deep water be too deep-laid, and certain factors, for instance lack of oxygen [being covered with sand and mud] would prevent the fungi from thriving.

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[1]) I give this name to the Olpidium-shaped marine forms with uniflagellated zoospores and with a limited number of channels for the zoospores (= several Pleotrachelus forms).

The greater number of these fungi probably winter by means of their resting-spores. Some of them seem to be able to vegetate during the winter. Thus I have several times during frostless periods of the winter found *Achlya*-vegetations on branches; they were not vigorous, but yet they were alive. As to vegetations on dead fishes I may mention that on January the 5th, 1902, I found a great many dead Leuciscus sp. in a pond close to the forest of Ruderhegn attacked by a *Saprolegniacean.* On the whole there is no real growth during the winter. In my opinion it is not so much the low temperature that is the cause of this, many species thriving during early spring in water which is near freezing-point, as the fact, that the vegetations during winter are frozen up. According to my experience, congelation during a short period need not have a deadly effect on the mycelium, but a long period of congelation is no doubt absolutely destructive. At any rate, degrees below zero have a paralyzing influence on the Phycomycete-mycelium. The life of the Phycomycetes in our fresh-waters does not commence until the beginning of March, when the ice has been very thick, somewhat later (in April, May). From that time we find almost everywhere vegetations of *Saprolegniaceae* and other forms of vegetable substratum, on living and dead fishes, etc. The attacks on the Plankton-crustaceans do not begin until June-July. I shall begin by describing the first groups in detail.

α. *Parasites on fishes, frog-eggs and such-like*; *Saprophytes.*

Saprolegniaceae. Among living organisms, representatives of this group usually attack only fishes and the spawn of toads. According to verbal information kindly given me by Mr. Löfting the „fishery expert", there do not exist in Denmark epidemics in nature so severe as those, which destroy the fish fauna in lakes and rivers of other countries[1]). According to the statements of Mr. Löfting, the fishes of our natural waters are not particularly troubled with slight attacks of these fungi, such as was the fact for instance with the fishes which was brought to the market in Zürich (Maurizio, 1896, p. 8). On these fishes the vegetations were on the soft part of the epidermis, through it were not possible, according to Mr. Maurizio to trace any injuries as the cause. In Denmark the attacks are no doubt especially confined to some few individuals which have become seriously injured. Thus I have once observed in the lake of Fure Sö a bitten and sick bream with the wound quite overgrown with *Saprolegnia*-hyphae[2]). Sometimes I have found frog-eggs, which

[1]) It is irrelevant to the matter in question that fishes in fish-ponds and hatcheries have proved to be attacked. The conditions connected with artificial pisciculture are not the same as in nature.

[2]) On June 14th, 1909, Mr. O. Hessellund sent me a ten-spiked stickle-back (Gasterost. pungitius) which had been caught in the brook of Ladegaardsaaen; I was

were attacked. The hyphae grow in the jelly around the eggs, and then penetrate into them. Among dead animals we find above all fishes overgrown with these fungi; next we find serving as substrata, toads and frogs, leeches and earth-worms, crag fishes and snails, as well as air-insects, which fall into the water and are drowned. Fishes and air-insects are attacked at all periods of the year from the spring to the fall, — but the former, as well as toads and other animals, which often die during the winter for want of oxygen owing to the water being covered with ice or for other reasons, and which in the spring come up to the surface and are carried to the shore, are found quite overgrown with these fungi, particularly in the spring[1]). Generally it is only the soft parts of the snails, which rise to the surface. They form gelatinous liquid lumps. Species of *Saprolegnia* are especially found on these substrata, but often the genus *Achlya* and other genera are also represented. The mycelium covers the animals with a thick grey felt, in which bacteria and other organisms thrive exceedingly well. These *Saprolegniaceae* thrive only, so to speak, tolerably well during the first period of their life. Gradually as the putrefaction their animal substratum advances, the bacteria and infusoria increase in number, and the growth of the fungi is checked. At last they succumb, often without having produced fructifying organs. The tendency to Apogamy and Parthenogenesis, that we find in the *Saprolegniaceae* is possibly connected with these unfavourable external conditions.

When air-insects, for instance gnats or Podura, occur in great numbers and fall down into the water for some reason or other, the vegetations often form a sort of grey felt on the surface of the water. I may instance the tegumenta of the nymphae of the Phryganeae as a special animal substratum. They are generally attacked by *Saprolegnia*, *Achlya* and *Aphanomyces* sp., but owing to the smallness of this substratum, the forms in question do not obtain their usual size. These tegumenta of nymphae serve also as substratum for several species of the *Chytridineae*.

It is evident that the water in early spring time, owing to its low temperature, is most fit for the growth of *Saprolegniaceae* on animal substratum, as fishes, etc. Setting aside the fact that many of the above mentioned nutritive substrata do not exist in summer time, it is impossible to point out any decrease in the occurrence of these fungi during the summer season. Much vegetable life in water-pools as well as impurities in the water checks the growth of these fungi yet not to such a degree as is the case with fungi on branches.

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told, that it was swimming about quite happily, though the whole of it was covered with a thick mantle of hyphae; it was much infested with *Saprolegniaceae*.

[1]) Individuals with *Saprolegniaceae* are most often found in places, where dead roaches and similar bait for fishes are numerous.

The vegetable substratum, on which the *Saprolegniaceae* live, is of an entirely different nature. The most used substrata are the commonly occurring branches and shoots of trees and bushes (though scarcely those of the genus *Salix*, owing to their containing salicine), which either in a living state have fallen into the water, or have lain on dry land for some time, or have fallen down in a dry state, but which have not, at any rate lost their bark. Secondary in importance rank for instance old rhizomes of *Calla*, half-rotten leaves and leaf-stalks of *Nuphar* and *Nymphaea*, fruits of *Iris* and other parts of aquatic plants, which float on the surface. Further, but less frequently the following are used as substrata: fresh herbacious land-plants or parts of these, which for some reason or other have fallen into the water, buds and fruits of living trees and herbs, which have fallen into the water. Upon the whole it is astonishing how few aquatic plants are used as substrata. No living plant in situ is attacked. They cannot possibly be attacked unless for some reason or other they have been displaced as happens for instance with the rhizomes of *Calla*, or unless they are entirely or partly dead, but this attack extends only to the dead parts. Fresh living roots of trees and bushes, which grow in the water, are not attacked.

When trees dip their branches into the water, the ends of these branches generally die, and then as mentioned above they form an excellent substratum for the *Saprolegniaceae*. Further, I have often observed that the fruits of *Enodium (Molinia) coeruleum*, which happen to dip into the water, are attacked by *Achlya* species. Leaves of trees and bushes, which every autumn fall in great number into the water never serve as substratum for the aquatic Phycomycetes.

The species of *Saprolegniaceae* which are especially united to vegetable substrata, are in most cases referable to the genus *Achlya*. Therefore the following remarks deal more especially with the latter.

A certain contrast is exhibited in the vegetations on herbacious substratum which in particular is liable to putrefaction, and those on older branches. On the former the vegetations are shaped like those of the genus *Saprolegnia* on animal substratum; the hyphae are close together and form a felt and the vegetations are often injured by the putrefaction of the substratum. On old branches the vegetations often occur in clusters, localized at the orifices of the lenticels. Very often I have found *Achlya*-hyphae, based on cushions of Mycomycetes, but I do not know, whether these also serve as nutrition-matter for the hyphae. Lichens do not seem to be of any importance as substratum. Vegetations on putrefacious substrata are generally destroyed very quickly, while on the older branches they are able to exist for a very long time, apparently during the whole summer. The hyphae of such vegetations have generally thick membranes slightly yellow in colour, and many among them seem to be

in a sort of resting-state. Upon the whole the vegetations of older branches are not injured so much by the presence of bacteria and infusoria as the vegetations on substratum which is liable to destruction. On the other hand their existence is threatened by other factors. Most branches remain only for a short period on the surface; when they are saturated with water they sink to the bottom, and the vegetations are not able to keep alive, unless it takes place in shallow water. All factors, which prevent the renewal of the water around the hyphae, for instance mud, mire, blue-green algae occurring in masses, have a fatal effect on the hyphae. By reason of this, these fungi are liable to be injured, where Algae or Plankton occur in abundance, or when *Lemma* or other higher plants cover the surface. When the branches on which they grow are covered with sponges, cushion-algae, etc. they instantly succumb to these organisms. If the water is the home of the larvae of Phryganeae and similar insects they don't find an apportunity for growing; the branches on which they are living get eroded. For these reasons many water-pools or at any rate parts of these are often quite devoid of vegetations of these species of *Saprolegniaceae*. Upon the whole the summer time with its great vegetable and animal life does not appear favourable to vegetations on branches. While the Saprophytes on animal substratum, and for the matter of that also the Saprophytes on vegetable putrefacious substratum, generally occurring close to the surface of the water, because the substratum in question does not sink to the bottom before they arrive at a state of decay, in great vegetable associations can find small open spots on the surface of the water and sufficient current of air, the vegetations on branches in such associations are more unfavourably situated, because the branches sink more rapidly beneath the surface, so that there is a possibility of their being totally deprived of fresh air. Hence the best developed vegetations on these substrata are found in spring-time and early summer.

In the foregoing I have insisted upon certain conditions, which are necessary to the growth of the Saprolegniaceae, and I have laid great stress upon the influence of everything that hinders the supply of oxygen around the hyphae. These conditions are however not the only ones. As partly indicated in the beginning of this part, it is moreover necessary that the water should be relatively quiet, without any dashing of the waves or strong current, that it is fairly pure, not filled with putrid organisms or their products, that it does not contain much iron, that there is a relatively open and light surface. The quantity of lime and humus contained in the water is of no importance. What should be noted is the fact, that the nature of the soil is favourable to certain plants, which certain Phycomycetes seem to favour. The temperature of the water is probably of a certain importance with regard to the formation of the oogonia; in most cases probably a rather low

temperature[1]) is necessary; with regard to the growth of the species, the temperature which prevails during summer time is scarcely of any importance. Shady localities do not seem to favour the development of these fungi. I do not know the reason of this fact, the absence of light in itself exerts no bad influence on the *Saprolegniaceae*. They only thrive in light and open places.

The above named conditions being present[2]) there is no doubt that even the smallest water-pools, where favourable substrata are found, will contain vegetations of *Saprolegniaceae* or their germs. Experience proves that it is easy by means of ant-eggs and dead flies to produce vegetations of these fungi from most water-pools. The species not always occurring in vegetations, it is necessary in order to explain this phenomenon to fall back upon other factors than the resting-spores, which in many cases, where bacteria, etc. check the growth of the hyphae, are not formed at all, or at any rate but in very small numbers. It is probable, as has first been indicated by Maurizio, that gemmae and fragments of mycelium, produced by the germination of the zoospores, are suspended everywhere in the water where the *Saprolegniaceae* are growing or have been growing. For the rest, the zoospores which are found in most species, and which are produced in great numbers undoubtedly are of great importance to their distribution in the water.

We know that the real period of the *Saprolegniaceae* begins in the spring and generally closes in November, but we are really very much in the dark as to whether the mycelium, which once has formed resting-spores, is able to repeat this process several times during the same summer. The well known experiments of Klebs on the *Saprolegnia mixta*, confirmed by Kauffman, 1908, to which I shall return later in this paper, seem to indicate, that at any rate certain species, the external conditions being favourable, are able inceasingly to produce resting-spores. Other experiments made by Kauffman and myself seem on the other hand to indicate, that there are species, which form resting-spores with great difficulty. Most probably such forms pass through a cyclus of vegetative and resting stages, corresponding to the cyclus in higher plants. *Achlya racemosa*, one of the most common species on vegetable substratum, appears to be referable to this category. In summer-time and far into the autumn ripe oogonia are found in situ on hyphae, but young ones are never found. Such I have only found in the spring: on March 18th, 1903, I found this species with unripe oogonia in a ditch in the forest of Ruderhegn; the temperature of the water was 5° C. On March 25th,

[1]) Comp. the following remarks on *Achlya racemosa* on this page and p. 510.

[2]) Even if a water-pool does not appear favourable to Saprolegniaceae, there will in most cases no doubt be a single though perhaps small place, where the conditions are favourable.

1903, I found it at the same stage in the swamp of Seidamsmosen in the forest of Jonstrup Vang. I likewise found it on April 3rd, 1903, in the pond of Charadam in the wood of Böndernes Hegn adjoining the village of Bagsvaerd. On April 29th, 1903, I found fully ripened oogonia in ditches south of the lake of Lögsö in the wood of Ruderhegn. The year 1904 was characterized by much ice towards the end of the winter, but already in the middle of April I found this species, in the act of fructification. In 1905 I found the fructification stage on March 3rd in a ditch near the pool of Storkevadskaeret in the forest of Gribskov; the temperature of the water was 3—4° C. In my material from the above-named pond of Charadam on March 24th, 1904, and from the swamp of Böllemosen on March 22nd, 1908, I obtained a short time after the material had been collected and carried into the laboratorium, abundant fructification. Hitherto it has been impossible to obtain later fertilizing individuals from this culture. It is just possible that a low temperature is of importance for the greater part of other species, as well as for *Achlya racemosa*, but we do not know much about this question as yet. Klebs asserts, that be has found oogonia in *Saprolegnia mixta* at a temperature of 6—8° C. It has already been mentioned that hyphae and gemmae during favourable periods are found in the winter. Yet this fact is not incompatible with the view that the greater part of these forms winter by means of resting-spores.

It is a well known fact that many water-pools and ditches dry up in summer-time, never the less such localities often contain during the damp period a great number of vegetations of *Saprolegniaceae*. According to my experiments it is evident that mycelium-fragments and[1]) gemmae cannot stand being dried up. Probably the resting-spores preserve the species during the drying up, though they often occur sparingly. I have made use of dry material for production of vegetations. In many cases the experiments have failed, yet I have certainly obtained cultures of *Saprolegniaceae* from a material, which had been in a dried state for several years.

Other saprophytic Oomycetes on vegetable substratum require on the whole the same conditions as the *Saprolegniaceae* and in biological respect they are similar to these. I shall briefly mention these forms.

The *Leptomitaceae*. The most common species of this group is *Apodachlya pirifera*. It occurs especially on branches, which have fallen down, and often together with forms of *Saprolegniaceae* and *Monoblepharidaceae* and is here especially found associated with the *Monoblepharis*-species, a fact, which has previously been stated by Lagerheim. I have but rarely found independant vegetations of this species, most often they occur as simple hyphae or in the vegetations of other forms. This species appears to have its most favourable period during the cooler months of

[1]) Drying up of vegetative mycelium on glass-plates (object-slides).

the year. The other representatives of this family, *Sapromyces* and *Rhipidium*, occur but seldom. The vegetations of the latter always occur, surrounded by Bacteria-colonies. This also applies to the *Blastocladia* within the *Blastocladiineae*. *Rhipidium* and *Blastocladia* are Saprophytes on branches of ash, fir, apples etc. *Sapromyces* occur on similar substratum. As for the representatives of the *Monoblepharidineae*, here in Denmark, judging from the experiences already gained, only species of the genus *Monoblepharis* occur in the same way as species of *Saprolegniaceae* on different kinds of branches that have fallen down, and behave biological speaking in a similar manner to these. The vegetations are always much more enveloped in colonies of bacteria (often reddish) than the *Saprolegniaceae*. We have two species of *Gonapodyineae* in Denmark: *Gonapodya siliquaeformis* and *polymorpha*. The first-named species seem to occur on different sorts of branches, and they are greatly worried by the presence of Bacteria around the hyphae. *Gon. polymorpha* is often found on spruce fir branches, where it vegetates in the jelly which has been formed through the destruction of the resin.

Within the *Peronosporineae* we have the genus *Pythium* as partly submerse genus. Now and then I have found saprophytic genera of *Pythium*, but I dare not make any conclusive statements with regard to the biological circumstances of this species.

β. *Parasites on Plankton-crustaceans.*

In the literature of foreign countries, I have but once met with mention of the Phycomycetes on crustaceans, viz. in a paper by Lagerheim (1900, p. 17), who states that he has found in lake Malmagen in Sweden the Holopedium gibberum attacked by *Pythiopsis cymosa*. In this country Leptodora Kindtii Daphnia hyalina and cucullata as well as Bosmina Coregoni have been found attacked by the Phycomycetes. The disease on Leptodora Kindtii is according to my investigations due to the *Leptolegnia caudata*. This disease was first mentioned by P. E. Müller, who had observed it in the lake Bögholm Sö in Seeland and other lakes. He writes on this subject[1]):

„In a course of a few days (towards the end of August), this fungus had become so prevalent, that it was very rare to meet with a Leptodora which was not attacked and in a week it had almost exterminated this animal from the lake (Bögholm Sö) where it occurred in great number. For three consecutive years and almost at the same time I have observed the destructive effects of this form." This disease has afterwards been observed in the lake Fure Sö by Dr. Wesenberg-Lund, whose experiences on this point have been of great use to me.

[1]) P. E. Müller: Bidrag til Cladocerernes Forplantningshistorie. Naturh. Tidsskrift, 3 R, V Bd., 1868, p. 296 Anm.

As to my investigations with regard to this disease they only refer to the Fure Sö. They took place in June—July 1902 and in the summers of 1904 and of 1905.

The attack on Leptodora takes place in the maximum period of this animal, which according to Wesenberg-Lund[1]) lasts from the middle of July until the middle of September. In the year 1904 I observed a very severe attack already on July 22nd and in 1905 on July 7th, single individuals were already attacked. But according to the observations of of Wesenberg-Lund the attack does not seem to take place until the middle of August and not later than the middle of September. In the year 1904 the attacks continued during the whole of August and did not cease until the ordinary time.

I have not succeeded in ascertaining conclusively where the fungus penetrates into the crustacean, but examination of young mycelium seems to show, that the entrance most often takes place around the opening of the mouth. The mycelium spreads rapidly, kills the animal and finally envelops both the mother individual and the eggs with a thick mesh work of hyphae[2]). The infection always seems to be fatal. The hyphae which protrude from the crustacean forward a great number of zoospores (the whole contents of the mycelium may be used up in order to form these), which in a very short time cause the infection to spread greatly. This formation of zoospores is not confined to a short period, it seems on the contrary to last a long period, so that the one generation of zoospores successively displaces the other (counted from zoospore to zoospore) without the power of forming zoospores being diminished. This circumstance may cause the attacks to be dangerous to the existence[3]) of the Leptodora. The formation of the oogonia does not seem to take place until the end of the life-time of the fungus. Whereas the individuals which have thus been injured by the mycelium in the zoospore-forming stage only slowly go to the bottom and are therefore most easily obtained near the surface of the water, the individuals provided with resting-spores seem to go more rapidly down to the bottom.

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[1]) C. Wesenberg-Lund: Studier over de danske Söers Plankton, Spec. Del I, Kjöbenhavn 1904, p. 181.

[2]) P. E. Müller's description of the disease is as follows: On the specimens of this crustacean, which I regularly brought home every second day from Bögholm Sö, I observed about the 20th of August a *Saprolegniaceae*-shaped fungus, the mycelium of which developed beneath the membrane of a great number of individuals enveloping all the organs and finally killing the animal. At the same time solitary club-shaped reproductive organs shot through the membrane of the crustacean.

[3]) Compare here P. E. Müller's previously cited remarks. Wesenberg-Lund informs me that in the year 1900, in the beginning of September, he was scarcely able to procure an individual which was not attacked.

Upon the whole the formation of resting-spores, which only occurs on the intramatrical mycelium, does not seem to be frequent. But neither are many resting-spores necessary; owing to the formation of the zoospores the fungus spreads rapidly and surely. It is supposed that the resting-spores rise to the surface previous to germination, which probably takes place the following summer, but nothing certain is known of the matter in question; the period of the fungus is finished by the middle of September.

This attack is probably of great importance to the life of the plankton-crustaceans in the above-named lakes, as it diminishes the number of the Leptodora, this species being a pronounced rapacious crustacean, which feeds on other plankton-crustaceans.

The fungus which attacks Daphnia hyalina and cucullata as well as Bosmina Coregoni belongs to the *Pythiaceae* and, so far as I can judge, it seems to be a question of one species, only *Pythium Daphnidarum* mihi. This attack of the fungus has been met with in several lakes in Denmark: in the Fure Sö (Daphnia cucullata and Bosmina), in Esrom Sö (Daphnia hyalina) in Hald Sö (Daphnia hyalina), but no doubt it occurs in many other lakes. This fungal attack has in this country been recorded by P. E. Müller and Wesenberg-Lund[1]). As to myself I have only observed it in the lakes of Fure Sö and Esrom Sö, and my particular studies on this point are confined to Fure Sö. According to the statements of Wesenberg-Lund, the attacks on the Daphniae begin when the last generations of the spring-forms (the short and more clumsy forms) are egg-bearing[2]) (the first generations of the forma galeata), which takes place in the end of June or in the beginning of July, according as to whether the spring has been cold or mild, about which time the maximum of these species begins; it closes towards the beginning of September.

According to my observations in Bosmina, the infection probably takes place by the zoospores forwarding germination-threads through the dorsal salves. Yet the zoospore is supposed sometimes to penetrate into the part surrounding the eye. The fungus attacks partly the body of the animal partly the eggs, the whole is enveloped in a thick mycelium and is soon killed. The zoospores are formed in the extramatrical parts of the mycelium. Certainly, many zoospores may be produced, but the number of these appear to be very much less than those of the *Leptolegnia*. The cause of this may be explained by the difference in the formation of the zoospores that exist in the two genera. The zoospores spread the disease, but in accordance with their small number the infection never seems to be of such great extent as it is with respect to the Leptodora. Now and then in certain years a maximum is traced; this

[1]) Wesenberg-Lund op. cit. pp. 167 and 169.

[2]) The remarks of N. E. Müller on this subject are but brief. Wesenberg-Lund was the first who clearly recognized the presence of a special disease.

takes place towards the end of June or during the first half of July and scarcely lasts more than 8—10 days. But often the attack is sporadic throughout the whole period. A maximum occurring, the attack does not cease with this, but continues sporadically during the rest of the period (until the middle of September). The resting-spores, which are intramatrically formed, seem to occur always at an earlier stage, about the middle of July, which circumstance no doubt checks the distribution of the fungus. Their germination is not known. — I have only once had the opportunity of studying the attacks on Bosmina Coregoni, viz. in the Fure Sö July, 1904. On that occasion a slight maximum of the disease occurred. I dare not say for certain whether the Bosmina is attacked regularly every year, but I am inclined to believe so. Wesenberg-Lund, the most experienced investigator in this field, mentioned this epidemic on Bosmina as a phenomenon he had never observed before, and it is just possible that it may be a rarely seen phenomenon, which only occurs, when the year is favourable to the development of the fungus, and when for some reason or other the individuals of Daphnia are but small in number. In other words the Bosmina is but secondary as a substratum for the fungus. In the year, in which the species of Bosmina and Daphnia are equal in number, the zoospores of the fungus evidently prefer the latter, owing to some qualities which these possess; the Bosmina is probably attacked too, but sparingly.

II. Micro-Oomycetes (Micro-Zygomycetes): Chytridineae.

As well known the parasitic forms occur on algae, in the hyphae of higher Phycomycetes and in the eggs of different low-organized animals (for instance Rotatoria) as well as in Anguillulinae, etc. The saprophytic forms are but small in number; they occur in the tissue of higher aquatic plants, in parts of different insects, for instance, in the tegumenta of the Nymphae of the Phryganeae, on the wings of certain insects, and in the pollen grain of different plants, especially of fir and spruce, great quantities of which are blown down into the Freshwaters.

The most important condition for the thriving of the *Chytridineae* is in the first instance quiet water, a condition which the living host-substrata also require in most cases. The *Chytridineae* do not occur in vegetations of Algae, to be found on shores where the sea runs high, even if certain of the existing algae may harbour the *Chytridineae* under other circumstances. The same may be said regarding the forms of the tegumenta of the Nymphae of the Phryganeae. If these are blown together on a shore, where there is no shelter, no *Chytridineae* will be found, unless the weather has been fine for some time. While there are no places on the east shores of Esrom Sö where the *Chytridineae* are able to thrive, they find more favourable conditions on the shore close to the forest of Gribskov, especially in the neighbourhood of Sölyst, where the water is

relatively quiet, even with a strong west wind. There are many excellent localities within the belt of *Scirpus-Phragmites*. This lake is similar to many other lakes. Upon the whole the wind is of importance with regard to the development of algae in a particular place. Where a water-pool is almost devoid of these, it would no doubt be easy to prove that it is exposed to the wind, owing to an unfavourable position. Neither are algae in running water attacked.

Although the quantity of lime and humus substances scarcely is of importance for the *Chytridineae* it is by no means impossible, that the presence of a certain amount of organic matter in a decaying state may be of consequence to them. As far as my observations go most *Chytridineae* are found in localities, where the water is not entirely pure yet there must not be a great amount of Sulphur-Bacteria or an advanced putrefaction. According to my own experiences, water containing ferric oxide is to a very great extent avoided by the *Chytridineae*.

We may expect to find *Chytridineae* in localities, where the above-named conditions are present, and where no special circumstance, for instance a thick cover of *Lemmae* or of *Cyanophyceae*, checks all other life. Certain algae communities are not much worried by attacks from *Chytridineae*, for instance the associations of the *Cyanophyceae* or of the *Confervaceae*, in the *Sphagnum*-bogs; most often these fungi are found in algae of the group *Conjugatae*, and on *Oedogoniaceae*. Probably the attacks are in most cases sporadic. I have only observed very few real epidemics, such as have been observed in several localities abroad. The most severe attack, which I have observed, was an attack of *Lagenidium Rabenhorstii* in *Spirogyra* sp. August, 1902, in a pond close to the Stenholt Mölle near Hilleröd, and an attack of *Chytridium spinulosum* and *Phlyctochytrium stellatum* in July, 1902, in a big species of *Spirogyra* by the shore of the Rostgaard's Dam in the wood of Danstrup Hegn.

The saprophytic forms, for instance, *Rhizophidium pollinis* on pollen grains, may be present in great number, if only there is sufficient material of this substratum.

The chief period of the *Chytridineae* takes place from the middle of April until September, most of the substrata only occurring at that time. It is just possible that there may occur *Chytridineae* on the algae, etc. which winter or appear in early spring, while the temperature of the water is still low. I have no personal observations to go by, but Zopf and de Wildeman mention some cases, which justify this supposition. On the other hand I have found out that *Chytridineae* parasite on the forms of Saprolegniaceae which occur in early spring or live through the winter. I found for instance *Woronina polycystis* on the hyphae of *Achlya* in February, 1903, in a ditch with birches adjoining the wood of Ravnsholt Plantage and on *Achlya racemosa* on March 3rd, 1903, in a ditch in the

wood of Ruderhegn (the temperature of the water was in the last mentioned locality 5° C). Even in the month of April the parasites on *Saprolegniaceae* and on animal substrata may be found (eggs, etc.). The parasitic life on the algae does not begin until the month of June. The saprophytic forms on the tegumenta of the Nymphae of the Phryganeae are mainly found from the middle of May until the beginning of September.

I have no knowledge of the facts regarding the life-cycle of the *Chytridineae*, the number of the generations which occur from zoospore to zoospore. Some easily form resting-spores, others form them with difficulty, but my knowledge is limited as to these facts.

B. Geographical remarks.

The outward circumstances which are the conditions of the occurrence of the higher submerse Phycomycetes are as above named, viz: that the water be comparatively quiet and open, that it shall not contain too much ferric oxide and lime, and above all, that it must not be too muddy; and finally the water-basins in question must not be of too short duration or too shallow, so that they can be exposed to great heat. These conditions and the proper substratum being present, vegetations of the higher Phycomycetes are generally to be found. Further, it depends on the sort and amount of the substrata as to which species we shall find. Water-basins: pools, small lakes, etc. which occur in districts, devoid of trees or which for some reason or other have no arboriferous vegetation along the shores, for instance the lakes in the western parts of Jutland, in the tracts of the downs and the heaths, marl-pits and watering-pools and other localities will preferably be the home of *Saprolegnia* sp. and similar parasitic-saprophytic forms, while we also find *Achlya* and other saprophytic forms, etc. in places where there is a chance of branches falling into the water, for instance in all lakes and ponds in the woods (on the other hand not in the dark water-pools in the hollows of the woods). We shall scarcely find either the one or the other species in water-pools, which are either shallow or of a short duration, or in places, where animal and vegetable life is of no importance. This is the case with regard to the lakes on the heath of Karls Maersk and certain lakes on sand-bottom in the Himmelbjaerget district in Jutland.

With regard to the distribution of the *Chytridineae* in Denmark, I have ascertained, that a region such as Himmelbjaerget does not differ from north Sealand. I have not gained any positive knowledge with regard to the occurrence of these fungi in the western parts of Jutland, in the tracts of downs and heaths. Upon the whole many water-basins in these regions, as for instance those in the heath of Karls Maersk, offer unfavourable conditions to the substrata of which the *Chytridineae* may make

use. However, I am of opinion that provided a full algal life is capable of thriving in such localities, there is nothing to prevent finding *Chytridineae* here too.

A great number of Fresh-water Phycomycetes have been described during the last 20 years, and a considerable number of Floras have been published; above all, central Europe has been subjected to investigations in this respect, but we have also particulars concerning the occurrence of these Phycomycetes from other parts of the world, Asia and Africa. But in spite of this, it is impossible to obtain reliable knowledge as to the distribution of most of these fungi. It is only possible to prove the occurrence of these fungi through very lengthy investigations. Yet we do get some particulars and these prove that certain fungi have considerable geographical areas. Certain species are found in the East-Indies, in the neighbourhood of the Caspian Sea as well as in Denmark; judging from information from North-America, the higher Phycomycetes flora of this area is almost the same as that of Europe.

70 species of Freshwater Phycomycetes have hitherto been found in Denmark. This number is inconsiderable in comparison with the entire number of known forms, but it does not indicate a particular poverty of species, as the hitherto described forms, obtained from different areas have only been found the one single occasion that they have been described.

Special part.

Oomycetes.

I. Macro-Oomycetes.

1. Saprolegniineae.

Species which belong to this group appear to have membranes which contain cellulose or substances related thereto.

Fam. Saprolegniaceae.

Certain of the species which belong to this genus are of considerable interest as far as the question of sexual reproduction is concerned. I shall enter more fully into this question.

Saprolegnia Thureti is known as an entirely parthenogenetic species which never produces antheridia. Certain other forms, for instance *Saprol. mixta*, appear to be partly parthenogenetic, only a small number of oogonia being accompanied by antheridia; finally a species as *Saprol. monoica* (P. Claußen 1908) is no doubt normal with regard to the fructification. A similar gradation of forms is evidently also found in the genus of *Achlya*. Judging from the controversy which has been carried on by certain investigators (Davis, Trow, Hartog) as to the fructification in certain species of this family it must be assumed that, upon the whole, many species, normally forming antheridia to every oogonium, have no real fructification. In short many things indicate that there is within

this family a tendency towards doing away with the process of fructification. The above named *Saprol. Thureti* has reached this extreme point, others still form traces of antheridia, others again certainly form numerous antheridia, but only a few of these fertilize actively. Finally we come to the pronounced sexual species.

In 1899 G. Klebs, the well known Physiologist, published the results of a series of experiments he had made with *Saprolegnia mixta* in order to find out how far the formation of oogonia and antheridia is dependent on certain external conditions. His results seem to show that the fertilizing process especially in the formation of the oogonia completely depends on certain external conditions. These being present, the process occurs. Since the publication of this paper, there have as far as I know, only been publisheed two papers in which similar questions are treated, viz: by Horn (1904) and Kauffman (1908). Both papers show that the various species of *Saprolegniaceae* vary greatly, as far as the conditions for the formation of the organs of reproduction are concerned. I have myself made a series of experiments in this problem of Klebs, the particulars of which I cannot give here, and owing to these experiments I am an adherent of the view, that the sex in the *Saprolegniaceae* is on the whole not determinable by external conditions. I may say that in itself there is nothing astonishing about this. It has also been observed in other groups that the conditions for the formation of different organs can not in ordinary cases be realized by means of external conditions.

In my opinion it is probable that the species in which the sexual process is not accomplished or in which there is an entire or partial Parthenogenesis, are just those species which are most easily induced to form resting-spores by means of the method of Klebs. In these genera the formation of gemmae and oogonia pass into each other. Not taking the exterior of these organs into account, there is scarcely any important difference in the nature of these nuclei. The gemmae and oogonia are here often formed in the same places. Judging from my own experiences it will probably be very difficult to obtain a formation of antheridia and oogonia by means of the Klebs method in the species in which the oogonia occur on particular branches and which are always pronouncedly sexual. The cytological conditions which are necessary to sexuality certainly depend on other factors than nutrition and temperature.

Considering that the *Saprolegniaceae* occur under the most unfavourable conditions, one cannot help thinking, that there may be a possible connection between these unfavourable conditions and the tendency to Parthenogenesis. As the sexual genera occur in conditions which are just as unfavourable as those in which the parthenogenetic ones occur, it is as yet impossible to establish this as a fact. Yet I dare say that the unfavourable conditions in nature often hinder the occurrence of oogonia and antheridia·

All the *Saprolegniaceae*, which I shall mention in the following pages, have been cultivated on flies and ant -eggs, as far as they have not been found determinable in nature.

Saprolegnia Nees von Esenbeck.

1. *Saprolegnia dioica* de Bary: Fig. I, c; de Bary 1883, p. 55, and 1888, p. 619.

Upon the whole I may say that the characters which are said to be peculiar to *Sapr. dioica* appear to be liable to variations, and the species do not seem to be distinctly separated from other species. The presence of intercalary oogonia must be considered necessary to the identification of this species. Humphrey is wrong in referring forms with only terminal oogonia to this species as he has done.

Several localities in North Sealand in cultures.

2. *Saprolegnia semidioica* sp. nov. Fig. I, f.

Thallus ut in aliis speciebus gen. Saprolegniae; fila 20—30 μ crassa; zoosporangia terminalia se renovantia. Oogonia terminalia globosa diametro c. 60—70 μ paucis foraminibus munita; oosporae (centricae?) c. 6—15, diametro c. 22 μ. Antheridia ramosa aut simplicia sub oogoniis oriuntur, monoico modo. Fila antheridalia et ad oogonium supra insertionem filorum antheridalium et ad alia oogonia crescunt. In culicibus muscisque mortuis paludis cujusdam ad Söbjaerg Sö in incultis Borris (Jylland), 8. 6. 1904.

This new species of *Saprolegnia* is especially distinguished by the above-named quality, viz: that the antheridial threads may grow partly on to the oogonium under which they adhere and partly to other oogonia.

I have found this species once only: in a swamp in the neighbourhood of the lake of Söbjaerg Sö on the heath of Borris and it had woven a great number of dead gnats together into a greyish carpet which covered the surface of the water.

3. *Saprolegnia monoica* (Pringsheim); Pringsheim 1857, de Bary 1881, p. 102; Fig. I, a.

With regard to *Saprolegnia monoica*, it has been shown that every oogonium must be accompanied by antheridia. The species *Saprolegnia mixta* de Bary is characterized by the fact of its resembling *Saprolegnia monoica*, but with the difference that only one half of the oogonia is accompanied by antheridia, and further, the oogonia are more porous. I must admit, that I am not able to show conclusively how the *Saprolegnia mixta* is to be distinguished from *Saprolegnia monoica*. I attach but little importance to the poration of the oogomia, and keeping in mind the experiments of Klebs we may suppose that in reality there also exists great variation with regard to the development of antheridia in the *Saprolegnia monoica*. The latter may vary towards *Saprolegnia mixta*, and this again towards *Saprolegnia monoica*. Owing to my ignorance of the real character of these

species, I have referred all the monoica-shaped forms to *Saprolegnia monoica*, even if certain characters of *Saprolegnia mixta* were present.

Several times in cultures from North Sealand.

4. *Saprolegnia paradoxa* sp. nov; Fig. I, d and e.

Hyphae erectae parce ramosae diametro 20—60 μ; zoosporangia prolifera, diametro partium terminalium hypharum. Membrana hypharum saepe crassa, usque ad 8 μ, ut in specim. veteribus Achlyae. Oogonia terminalia vel lateraliter sessilia; membrana crassa, c. 4 μ, dilute lutea vel

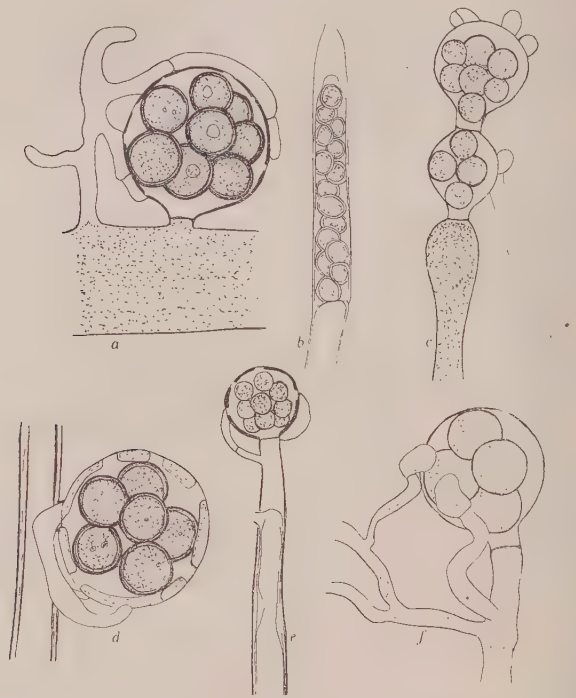

Fig. I. *a, Saprolegnia monoica; b, Saprolegnia Thureti; a,* zoosporangium-shaped oogonium; *c, Saprolegnia dioica; d* and *e, Saprolegnia paradoxa; f, Saprolegnia semidioica.*

hyalina et foraminibus multis munita, instructa. Diam. oogonia 50—100 μ; oosporae 5—20, diametro c. 25 μ. Rami antheridiales simplices, singuli, breves, sub oogoniis terminalibus et ex pedunculo oogoniorum racemose dispositorum gignuntur. — In ramis dejectis paludis cujusdam ad Gurre Sö (Nordsjaelland), mense Julio 1907 et ad Lille Grib Sö mense Martio 1903.

I feel doubtful, whether I am right in referring this species to the genus *Saprolegnia*. It is especially on account of the zoosporangia, which are prolifer, that I refer it to this genus. Yet this circumstance may be found in other genera. Thus I have seen zoosporangia, which had proli-

ferated in undoubted species of *Achlya*. I have often observed that this species has exceedingly thick membranes in its hyphae, so that in this respect it resembles other species of *Achlya* which live on branches. This circumstance and its occurrence on vegetable substratum appear to make the referring of this species to *Saprolegnia* still more dubious. Yet it is possible that the thickening of the membrane is caused by a parasite. At any rate as this species must either be an *Saprolegnia* or an *Achlya*, it deserves no doubt the name of paradoxa.

At all events it must be a new species characterized by the formation and shape of its antheridial tubes.

5. *Saprolegnia Thureti* de Bary; Fig. I, b.; de Bary 1881, p. 31 and 1888, p. 615.

In cases where the oogonia sit on short branches, it may be rather difficult to mark off this species from others, which are often devoid of antheridia, for instance, *Saprolegnia mixta*. For the fact is that these other forms probably are able to carry the absence of antheridia so far, that they become quite *Saprolegnia Thureti*-shaped; nor is it altogether impossible that *Saprolegnia Thureti* is able to form antheridia under certain conditions. Fig. I represents a zoosporangium-shaped oogonium within an older zoosporangium.

This species, or better forms, without antheridia are common in North Sealand.

6. *Saprolegnia asterophora* de Bary; Fig. III, h; de Bary 1860, p. 189; and 1888 p. 614.

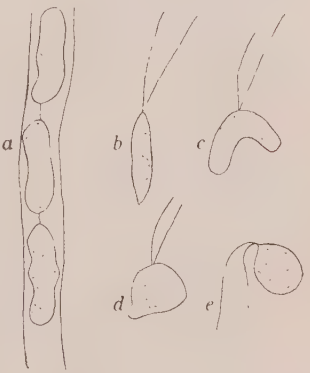

Fig. II. *a*, *Leptolegnia caudata*; *a*, the zoospores moving in the hyphae before the coming out; *b*, *c*, *d* and *e*, stages in alteration of form of the zoospores, *e*, the last stage.

Though I have not observed zoosporangia, I think I have found this species in cultures from a dead Leuciscus in a pond in the wood of Ruderhegn (Jan. 1907) and from a pond on Eremitagesletten.

7. *Saprolegnia hypogyna* (Pringsheim) de Bary. Pringsheim 1873, p. 196; de Bary 1883, p. 56, and 1888 p. 615; Maurizio 1894.

Saprolegnia hypogyna certainly comprises several species. According to the accounts both of Maurizio and of Kauffman, it seems to be liable to variations. — If the hyphae, which grow into the oogonia really have antheridial cells at the ends, then only a few of the eggs get fertilized Probably the species is partly parthenogenetic.

Two localities in North Sealand.

Leptolegnia de Bary.

8. *Leptolegnia caudata* de Bary; Fig. II; de Bary 1888, p. 631.

I have already mentioned (in the general part p. 512) the manner, in which this species attacks *Leptodora Kindtii* in the lake of Fure Sö. I shall here add some supplementary remarks. In the Leptodora the mycelium is characterized by the right angles at which the hyphae issue from one another. When the Leptodora is quite interwoven with the mycelium, the formation of the zoospores takes place. The hyphae protrude a good deal outside the animal. As already mentioned, all the protoplasm of the fungus may be absorbed in the formation of zoospores. I have not observed with certainty any formation of zoosporangia, evidently cross-membranes are not formed within the mycelium. The zoospores on escaping are hooked together by the flagella, one behind the other. These rows often have to make curious circuits, turn and twist, before they come into the parts of the hyphae from which they can get out. The zoospores on escaping are extended lengthwise, about 22 μ long with two flagella at one end. They are immediately capable of motion. While they are still moving before the orifice of the zoosporangium they form a V. shape, and then they contract until they get oval-shaped and their length is nearly half of what it had been. When swimming, they have the flagella in front of them. As mentioned before, the oogonia are but sparingly produced on this substratum. Observed in nature in the lake of Fure Sö, and a few times in culture from other localities.

Achlya Nees v. Esenbeck.

9. *Achlya racemosa* (Hildebrand) Pringsheim; Fig. III, d and i. Hildebrand 1867, p. 249; Pringsheim 1873, p. 205.

Judging from my own experiences this species fertilizes in nature only in early spring, when the temperature is low[1]), but the oogonia remain on the hyphae until the autumn. Owing to this fact it is extremely easy to identify this species in nature. On the forma stelligera the internal membrane within the wall of the oogonia pushes out through the thinner parts of the external (pores).

Oogonia of the main form as well as of the stelligera may occur on the same hyphae.

This species is common on the fallen branches of various species of trees and on other vegetable substratum (less frequent on animal substratum).

α) The main form.

Is common in northern Sealand and in Jutland.

β) forma stelligera; Fig. III d.

Rather common. The same places as the foregoing.

10. *Achlya decorata* sp. nov. Fig. III a and e. Syn. *Achlya racemosa* var. *spinosa*?[2])

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[1]) See p. 509—510.

[2]) Mr. P. Obel has recently (Ann. Myc. 4, 1910) supposed, that *Achlya decorata* is identical with *Achlya racemosa* var. *spinosa* Cornu.

Oogonia globosa, dense racemose disposita sine foraminibus, spinis conicis non vel parum coloratis plus minus cuspidatis munita. Diam. oog. sine emerg. 30—45 μ, cum. emerg. 45—70 μ. Ovum singulum. Antheridia (1—2) ut in Achlya racemosa.

In ramulis dejectis Fraxini excels. Ermelunden, Sjaelland.

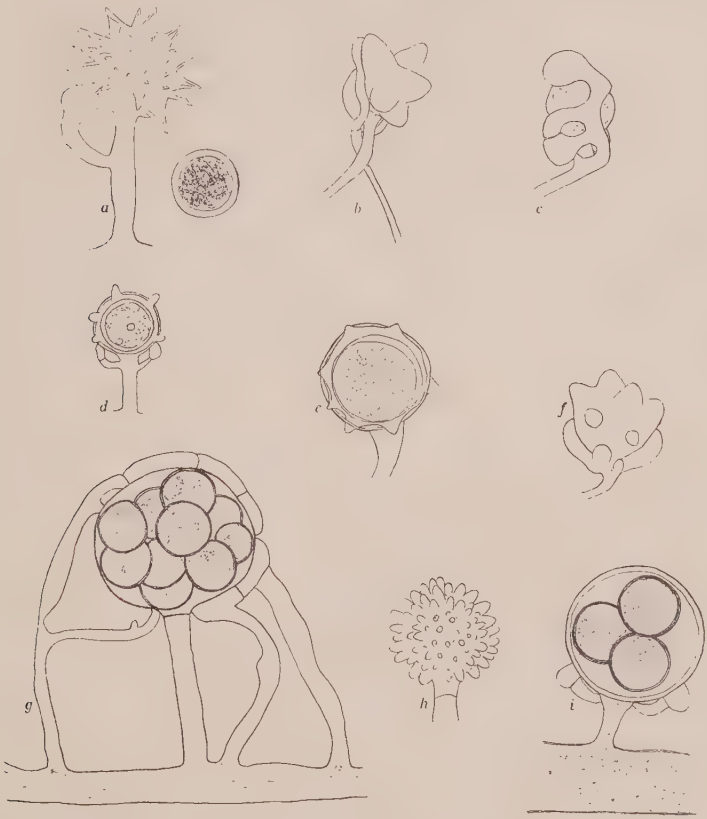

Fig. III. *a* and *e*, *Achlya decorata*; the ripe oospore is seen to the right in a; *e*, a stage of the evolution of the spines resembling the stage of forma *stelligera* of *Achlya racemosa*; *b* and *f*. *Aphanomyces coniger*, the antheridial tubes are seen; *c*, *Aphanomyces laevis*; *d*, *Achlya racemosa* forma *stelligera*; *g*, *Achlya polyandra*; *h*, *Saprolegnia asterophora*; *i*, *Achlya racemosa*.

It might be supposed, that this species should be regarded as a variety of *Achlya racemosa* and in this case it should be considered as a forma stelligera provided with pointed, conical protuberances. Against this view the following may be stated. On a hypha, which was closely covered with typical „decorata" oogonia, I observed a single oogonium, resembling those of *Achlya racemosa* and an oogonium belonging to a sort of intermediate

stage. Yet this intermediate stage did not altogether correspond to the forma stelligera (see fig. 3 e). Further, the oogonia in *Achlya decorata* are much closer together than in *Achlya racemosa*, almost compact. Yet this species is closely related to *Achlya racemosa*. The above named example proves that this species may vary towards *Achlya racemosa*, but I do not know the extent of this variation. The protuberances of the oogonia are developed from an internal membrane as is the case in „forma stelligera". But as I said before, the stages of the evolution of decorata have not much in common with the stages of stelligera. I have only observed it a single time in a ditch in the Ermelunden woods.

11. *Achlya polyandra* (Hildebrand) de Bary; Fig. III, g. Hildebrand 1867, p. 258; de Bary 1888, p. 634.

Humphrey (1893, p. 116) found in North America a species similar to *Achlya polyandra*, but with the difference that the wall of the oogonium is full of pores in this American species. He has named it „*Achlya Americana*". I have found only this form in Denmark. The reason why I do not make use of Humphrey's species-name, but place this species as a variety of *Achlya polyandra* is that I am inclined to regard these pores as variable characters, as there are always some oogonia, which have fewer pores than others.

β. forma *americana*.

Syn. *Achlya americana* Humphrey. Transact Am. soc. Philad. Vol. XVII. p. 116.

This species often occurs on fallen branches and other vegetable substratum (less frequently on animal substratum). In nature I have observed it in the lake of Grib Sö (on October 23rd in 1901) on birch.

12. *Achlya gracilipes* de Bary; de Bary 1888, p. 635.

This species lives both on animal and vegetable substratum but especially on the former. I found it three times.

13. *Achlya oligacantha* de Bary; de Bary 1888, p. 647.

I found this species but a single time in a culture from the lake of Aske Sö in the forest of Ruderhegn.

Aphanomyces de Bary.

In my cultures on flies and ant-eggs I have but rarely met with any species of this genus, and in nature I have with one exception only found this genus on the tegumenta of the nymphae of the Phryganeae, but on the other hand I have very often observed it here. As distinct from the tegumenta of the nymphae of the dragon flies, the tegumenta of the larvae of the ants, etc., the above-named tegumenta of the Phryganeae form an excellent substratum for the submerse aquatic fungi. These facts are probably due partly to the rich nutritive matter in these tegumenta, partly to their smooth, even surface and last but not least to the peculiarity that they often float for a long time in the water near the surface, and that during their first period they are but attacked to a certain extent

by Bacteria. These tegumenta having remained for some time in the water they become in most cases partly interwoven with a mycelium, especially in the wings, and partly they get covered with different sorts of *Chytridineae*. This mycelium belongs to different species of *Aphanomyces*, and of *Saprolegnia* and *Achlya*, but in most cases the two last-named genera are of no consequence at all. The mycelium of the fungi is always much branched, most branched in the *Aphanomyces*, and grows on and between the different membranes.

14. *Aphanomyces laevis* de Bary. Fig. III, c; de Bary 1860, p. 179.

It is most difficult to indicate whence the antheridia threads proceed, but I think I have observed that they issue partly from the oogonial branch partly from distant hyphae. When the fungus grows on the tegumenta of the nymphae of the Phryganeae, the antheridia cells become more or less thickly membraned, and adopt the colour of the membrane of the oogonium; sometimes they are quite club-shaped. This species certainly occurs in many varieties, but owing to insufficient material, I am not able to enter into details with regard to this question; I shall only intimate that it is a question of forms with greater or lesser oogonia and with smooth or rough membranes of the oogonia.

Beside the tegumenta of the nymphae of the Phryganeae I think I have observed this genus on an undeterminable substratum in a swamp adjoining of Dyrehaven woods.

15. *Aphanomyces scaber* de Bary; de Bary 1860, p. 178.

Once in the lake of Fure Sö in September, 1907[1]).

16. *Aphanomyces coniger* sp. nov. Fig. III, b and f.

In cutibus nympharum Phryganearum observata et in hoc substrato habitu Aphanomycis laevis mycelio ramoso. Mycelium diam. 5—15 μ. Oogonia sine foraminibus, membrana fusca processubus paucis conicis munita. Unum ovum. Oogon. diam. cum proces. 30—40 μ; proces. usque ad 8 μ; oospor. diam. 16—70 μ; antheridia in ramis ramosis partim androgynis partim e mycelio distante orientibus. Cellulae antheridiales in cutibus Phrygan. fuscae. In lacu Grib Sö 1907.

Not having observed with certainty the coming-out of the zoospores, I doubt whether I am right in referring this species to the genus *Aphanomyces*. As mentioned above it is distinguished by the brown-coloured oogonia (on the tegumenta of the nymphae of the Phryganeae) with great rounded protuberances of the membrane, more or less conical

[1]) In Journal de Bot. vol. XVII, 1905, I wrote a paper on the Phycomycetes-flora on the tegumenta of the nymphae of the Phryganeae in which I mention both *Aph. scaber* and *stellatus* as found. With regard to this I must mention, that I indicated *coniger* mihi as *Aph. stellatus*. When I indicated *Aph. scaber* as „assez fréquent", now I do not know, on what I founded this opinion. Judging from my preparations, I have only found this species in the lake of Fure Sö.

in shape. In this respect it resembles *Aphanomyces stellatus*, but it must not be referred to this species. As to the origin of the antheridial branches, it is almost the same as that of *Aphanomyces laevis*.

Only observed a single time in the lake of Gribsö (on August 8th, 1907).

As mentioned above I have very often observed the mycelium of the species *Aphanomyces* on the tegumenta of the nymphae of the Phryganeae, but I have only found oogonia in 12 cases in Jutland and in Sealand. Among the localities where I have found such vegetative mycelium I shall here only mention the lakes on sandy ground in the neighbourhood of Raabjaerg Mile near Skagen.

Aplanes de Bary,

17. *Aplanes androgynus* Archer. Archer 1867, p. 123.

Syn. *Aplanes Braunii* de Bary, Species der Saprol. Bot. Zeit. 1888.

I have only observed this species in the Sphagnum bogs, on branches of birch (three times in Sealand).

Fam. **Leptomitaceae**[1]).

Apodachlya Pringsheim.

18. *Apodachlya pirifera* Zopf. Zopf 1888, p. 362.

This species is very common on vegetable substratum, especially branches, but it rarely forms independent vegetations. Most often it occurs associated with *Achlya* and *Monoblepharis*. It appears to be a constant companion of the last-mentioned species (comp. Lagerheim 1900, p. 9). This species, as well as *Achlya* may be formed in a vegetating state during the winter. During 1900—1907 I found it 17 times. Yet I only once observed resting-spores (on May 19th, 1901, in a water-hole in Store Dyrehave woods). These organs appear to occur but sparingly. I have not later on made notes with regard to this circumstance.

This species is common, especially in the spring, but it has not been observed in the months of July, August and September. No doubt it occurs during these months, but only sparingly. I have observed it several times in cultures, but without noting the localities. Resting-spores appear to be rare.

Rhipidium Cornu.

19. *Rhipidium continuum* Cornu; Fig. IV, a, e. Cornu 1871; 1872, p. 15.

I have found it three times on branches of alder and once on birch and fir (North Sealand and East Jutland).

The vegetations of this species are always enveloped in swarms of bacteria; they occur in the shape of small white cushions, 1—2 mm. broad.

[1]) I have not found *Apodya (Leptomitus)* in Denmark, but I must add, that I have not investigated the localities where they are likely to thrive best, as for instance outlets from sugar-factories, etc.

Sapromyces Fritsch.

This genus is a sort of modified *Rhipidium* with a narrow basal cell, which is not branched, and from which only a small number of hyphae arise, with often verticillate sporangia. Thaxter appears to deny the presence of a special basal part[1]), differing from the hyphae, but I cannot agree with him. Upon the whole this genus somewhat resembles *Araiospora* [also with regard to the basal part], but it differs from the latter in not having cellular exosporium in the oogonium.

Fig. IV. *a* and *e*, ***Rhipidium continuum***; *b*, *c* and *d*, ***Sapromyces Reinschii***; in *c* the basal cell is shown; in *d* an oogonium with an antheridial tube.

20. *Sapromyces Reinschii* (Schroeter) Fritsch. Fig. IV, b, c, and d. Fig. V.

Schroeter 1892, p. 103; Fritsch 1893, p. 420; Thaxter 1896, p. 396; Reinsch 1878, p. 289.

Syn: *Naegelia* sp. Reinsch, *Naegeliella Reinschii* Schroeter.

A few more or less branched hyphae arise from a well developed, though not broad, basal cell, which hyphae are provided with constrictions. Zoosporangia terminal umbellate, single or verticillate, oval. According

[1]) Plants arising from a basal cell attached by rhizoids from its base and resembling in all respects the segments of the filaments, which arise in small number from its apex.

to Thaxter, the zoospores are provided with two flagella, and they emerge in a great vesicle, which soon bursts. The globular oogonia occur singly in the place of the zoosporangia. The membrane of the oogonium is colourless and smooth, the oospore has a peculiar thick wrinkled wall giving it a spiked appearance. The antheridia are on the long, thin filaments of declinous origin. Only one antheridium approaches the oogonium. This takes place in the apex of the oogonium, and the fertilizing thread penetrates in the same manner as in *Sapromyces androgynus* from above and downwards. In common with the *Rhipidium*, the mycelium of *Sapromyces* reacts with a purple colour on chlorojodide of zinc. I have only observed this species in the lake of Sorte Sö in the wood of Teglstrup Hegn in August and September, 1903 (fir).

Fig. V. *Sapromyces*-shaped vegetative form.

In four other places I have observed vegetative mycelium of *Sapromyces*-shaped species, but in these cases the zoosporangia were more cylindrical (cf. Fig. V). Probably we have to do with other species.

It appears for the most part to adhere to old branches of spruce fir and fir.

Fam. **Pythiomorphaceae.**

Pythiomorpha genus nov.

Mycelium ramosum, membrana chlor. zinc. jodato rubro-violaceo colorata. Propagatio adhuc cognita zoosporis duobis ciliis lateralibus munitis vesica non cinctis exeuntibus efficitur.

21. *Pythiomorpha gonapodyides* sp. nov. Fig. VI, VII.

Mycelium intramatricale ramosum irregulariter tumoribus et parietibus undulatis instructum. Mycelium extramatricale hyphis erectis non ramosis diam 4—5 μ constat. Zoosporangia terminalia ovalia diam. c. 44×22 μ. Zoosporae ut in Saprolegnia non vesica cinctae, ellipsoideae, duobus ciliis lateralibus munitae, diam 10 μ, exeunt.

Hyphae in et per zoosporangia evacuata penetrant et nova sporangia repetite formant. Oogonia et antheridia non observata. Chloreto zinc. jodato hyphae colorem rubro-violaceum accipiunt. In fructibus dejectis submersis Pyri Mali et ramulis dejectis Alni sp.

The extramatrical hyphae arise from an intramatrical, irregular, branched mycelium with irregular thickenings of the membrane. They are about 4—5 μ broad and not branched. The terminal sporangia of these hyphae are egg-shaped, and the broadest part is below. On an average they are 44×22 μ, and thinmembranated like the hyphae. The zoospores are 10 μ; they are ellipsoidal with the two lateral flagella as in *Pythium*. They all emerge at the same time, but

are not surrounded by a vesical membrane, and they are at once capable of movement. The sporangia are proliferous several times (Fig. VI, b and d). The new sporangia are either formed inside the old ones or at a little distance beyond them. The zoospores move in a straight direction for a few minutes, then on coming to rest they surround themselves with a thin membrane. Once I observed a zoospore, which started producing mycelium one hour and a half after having settled. I observed neither oogonia nor antheridia. By treating with chlorojodide of zinc the membranes of the hyphae adopt exactly the same colour as hygroscopic cotton. The protoplasm within the hyphae is highly refractive with distinct grains. The last-named are coloured yellow by chlorojodide of zinc, but are gradually dissolved by this substance. Hydrate of Potassium does not influence them. Presumably they are identical with the grains we find in the *Saprolegniaceae* and *Leptomitaceae*

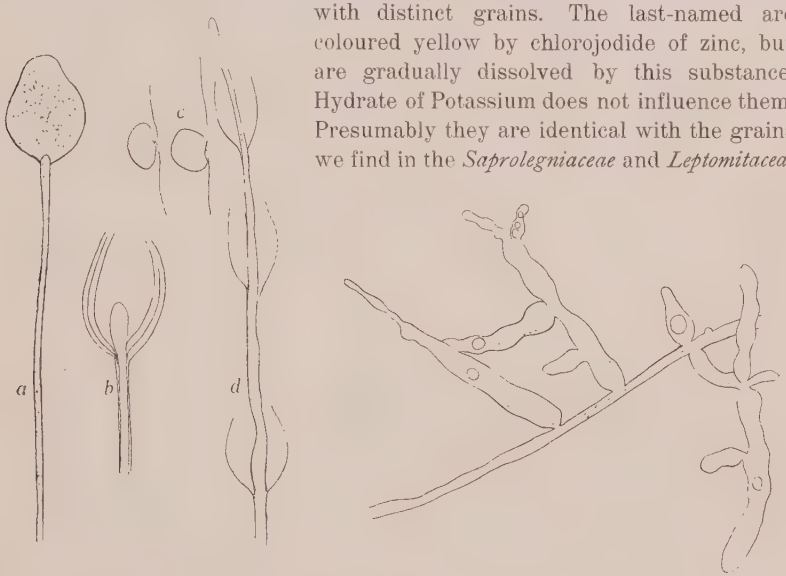

Fig. VI and VII. *Pythiomorpha gonapodyides*; VI, *a*, a zoosporangium; in *b* and *d* the manner of renewal of the zoosporangia is shown.

and most probably they consist of *Cellulin*. It is difficult to observe the nuclei.

Found on old apples in a pond in a garden in the neighbourhood of Glostrup in August 1902 and in May 1903, and in the channel near Frederiksdal, and on alder in a pond of alders in the wood of Ruder Hegn October 10th, 1902.

This species resembles *Pythium proliferum*.

Peronosporineae.

Fam. **Pythiaceae.**

Pythium Pringsheim.

Group Aphragmium Fischer, 1892, p. 397.

22. *Pythium gracile* Schenk.

Schenk 1859, p. 12; Butler 1907, p. 67.

I have often found mycelium in different algae which presumably belonged to this species. Once I observed oogonia (ditch near the village of Gentofte on October 13th, 1902).

23. *Pythium Daphnidarum* spec. nov., Fig. VIII, b and g.

Mycelium intramatricale glomeratum hyphas extramatricales (breves) plus minus clavatas emittens. Diam. hyph. c. 3—5 μ. Zoosporangia ut in

Fig. VIII. *a* and *d*, *Pythium undulatum*, a hypha with three zoosporangia; *b*, germinating zoospore of *Pythium Daphnidarum* in Bosmina; *c* and *f*, resting spores of indeterminate *Pythium* species in the tissues of higher plants, *e*, *Pythium proliferum*, renewal of the zoosporangia, g, *Pythium Daphnidarum*, oogonium with antheridium.

sectione Aphragmio. Zoosporae in vesica exuntes duobus ciliis lateralibus ut in Pythio munitae. Oogonia et Antheridia intramatricalia. Oogonia diam c. 30 μ, globosa, membrana tenui instructa unum ovum, diam c. 22 μ, continentia; unum antheridium in filo originis dubiae. In *Daphnia hyalina*, *Daphnia cucullata* et *Bosmina Coregoni* lac. Fure Sö, Esrom Sö et Hald Sö, Jan.—Sept.

The attack of this fungus on the two species of Daphnia and Bosmina Coregoni has been mentioned in the general part. I shall now give a more detailed account of the species.

Judging from my observations the entrance of the zoospore into the animal takes place through the dorsal valve. When the mycelium is fully developed within the animal, it is quite glomerate shaped and forms a thick tissue. The intestinal canal is entirely enveloped, but it is doubtful whether it becomes perforated. The mycelium sends out a greater or lesser number of unbranched hyphae through the animal. The zoospores come out through these hyphae which may be of a considerable length, and often form close tufts, but most frequently they are rather short. For a short time the zoospores move about in the vesical-membrane, but they separate when the membrane is dissolved. As long as they are in the vesical-membrane, they are kidney-shaped; when they swim, they are ellipsoidal; the flagella are situated as in the other species of the *Pythium*. I have found the zoospores in great numbers on the dorsal valves of the Bosmina; and as mentioned above I have observed cases where the penetration of the zoospores had taken place right through these (Fig. VIII, b). The valves are bent inwards during this process. The sexual organs do not show any peculiarities (Fig. VIII, g). Evidently no periplasm is formed. I have not observed fully ripe oospores. The protoplasm of the fungus is extremely oily.

This species is no doubt closely related to *Pythium gracile* and *complens*, and possibly in the future it will prove to be referable to one of these.

The group of Orthosporangium Fischer.

24. *Pythium proliferum* de Bary; de Bary 1860, p. 182, Fig. VIII, e.

This species resembles both the *Pythiomorpha gonapodyides* and the following species of *Pythium undulatum* mihi.

I have three times observed this species on the leaves and stems of old *Nymphaea* and on the decayed flower of a *Nuphar*.

25. *Pythium undulatum* sp. nov. Fig. VIII, a and d. Fig. IX.

Mycelium intramatricale difficile distinguendum. Mycelium extramatricale e hyphis non ramosis, longis, plus minus undulatis, diam. c. 3—6 μ, constat. Zoosporangia terminalia, ellipsoidea, interdum parva papilla apicali instructa, diam. c. 130 × 50 μ. Zoosporae duobus ciliis lateralibus munitae, diam. long. 15—20 μ, in vesica ut in Pythio, exeunt. Hyphae in et per zoosporangia evacuata penetrant et zoosporangia nova formant. Color membranae mycelii et zoosporangiorum leviter fuscus. Organa sexualia non observata. Frequens in laminis et petiolis (rarius gemmis) Nymphaeae albae et Nuphar. lutei.

It is difficult to trace the intramatrical mycelium; the extramatrical consists of long (often several millimetres), unbranched, more or less undulating hyphae. Terminal sporangia, seldom lateral. They open at the apex, sometimes with a papilla. The zoospores are similar to those in *Pythium*. When the zoospores have escaped sometimes new sporangia are formed within the old ones sometimes the hyphae may penetrate and not form

any sporangia until later on. The protoplasm is refractive; the membranes of the hyphae and sporangia more or less brownish coloured. This species seems to live especially on decaying leaves and stems of *Nuphar* and *Nymphaea*. Occasionally I found it on old fruits of Iris and on branches of trees. Several localities in North Sealand and Jutland.

Group Metasporangium.

26. *Pythium de Baryanum* Hesse; Hesse 1874.

I believe I have found this species once (February 3rd, 1907) in a ditch between the lakes of Hul Sö and Bagsvaerd Sö on the dead larva of insect.

Fig. IX. *Pithyum undulatum*. Fig. X. *Blastocladia Pringsheimii*; the different forms are shown.

No doubt the species of this genus of *Pythium* are much more common, than appears from this account.

Probably a great number of resting-spores which I have observed in decaying vegetable tissue may be referred to *Pythium*. But my experiences are limited to the above-mentioned facts.

3. Blastocladiineae.

Fam. **Blastocladiaceae**: no cellulose in the membranes.

Blastocladia Reinsch.

27. *Blastocladia Pringsheimii* Reinsch; Fig. X; Reinsch 1878, p. 291; Thaxter 1896, p. 45.

I have observed two sorts of individuals:

1. With a short and thick, often unbranched basal cell with rounded upper parts, from which the zoosporangia arise in the form of close tufts (Fig. X, a and b).

2. With slender (about 30—90 μ broad) branched basal cell (Fig. X, d).

Irrespective of the kind of basal cell the zoosporangia occur in two forms:

1. cylindrical sporangia about 190—200 × 25 μ (Fig. X, b) and

2. arched spindle-shaped, about 190 × 50—70 μ (Fig. X, a and e).

According to the experiences of Thaxter and myself, it is evident that the zoospores but seldom escape from the sporangia. Thaxter ascribes this circumstance to the numerous bacteria which rapidly settle around the individuals of this species, and no doubt he is right. The zoospores are amoëboid and uniflagellated. Resting-sporangia or resting-spores, which do not contain much substance occurred in great number in the place of the zoosporangia.

Found on apples and on branches of ash in 4 localities in North Sealand.

Fig. XI. *Gonapodya siliquaeformis.*

4. Gonapodyineae.

Fam. **Gonapodyaceae.**

Gonapodya Fischer.

The mycelium contains no cellulose.

Two species of this genus have been described: *Gonapodya siliquaeformis* and *polymorpha.*

According to Thaxter, they appear to be well defined and distinctly separated; but I cannot agree with this view, if the forms which I have found in Denmark should prove to belong to both species, which is extremely probable. I have found typical individuals of both species; that is an undoubted fact. But I have met with cases in which I was unable to decide whether I had the one or the other form before me. Further experiences may decide the question whether *Gonapodya polymorpha* not is a separate form of *Gonapodya siliquaeformis.*

28. *Gonapodya siliquaeformis* (Reinsch) Thaxter, Fig. XI; Reinsch 1878, p. 293; Thaxter 1895, p. 480.

The individuals are much branched (forked) with constrictions close together, and irregularly formed segments without long internodes. The sporangia are lengthy in shape with broader bases; often proliferous. According to Thaxter, the length of the sporangia is about 130 × 22, sometimes 200—250 μ long. I have not observed sporangia in Danish individuals which had the length that Thaxter indicates, nor were the length of

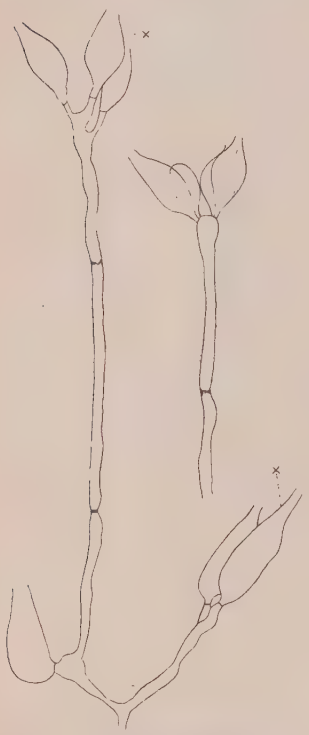

Fig. XII. *Gonapodya polymorpha*; the zoosporangia marked with an asterisc are respectively 52 and 54 μ long.

Fig. XIII. *Gonapodya polymorpha.*

the internodes in conformity with the indications of Reinsch and Thaxter. Yet in my opinion there is hardly any doubt, that the forms which I have observed are referable to this species.

I have found it six times in North Sealand on branches of different sort of trees.

29. *Gonapodya polymorpha* Thaxter, Fig. XII, XIII, XIV; Thaxter 1895, p. 481.

In contrast to *Gonapodya siliquaeformis*, where the growth is rather short and compact, the hyphae are often very long in this species. They

are extremely irregular with narrows and thickenings. In contradistinction from *Gonapodya siliquaeformis*, there may occur long stretches without any constrictions or thickenings. The zoosporangia are differently shaped, now long, now more elliptical, most often two or more are gathered at the end of the hyphae. According to Thaxter the length of the sporangium is 20—60 × 12—30 μ; the mycelium is brown. As the name of the species indicates, it is upon the whole extremely irregular.

The length of the zoosporangia of the Danish individuals often surpasses the length which Thaxter indicates. Upon the whole these individuals appear to approach *Gonapodya siliquaeformis*, though there can hardly be any objections to referring them to *Gonapodya polymorpha*.

Probably common on the branches of different sorts of trees. On fir and spruce fir it is found in the mucilage which is formed by the destruction of the resin. Several localities in North Sealand and Jutland.

Fig. XIV. *Gonopodya polymorpha*; zoospores which are transformed into resting-spores.

Monoblepharidineae.

Fam. **Monoblepharidaceae.**

Monoblepharis Cornu.

As to the individuals of this genus which I have found in Denmark, I have referred them to *Monoblepharis polymorpha* β *macrandra* Lagerheim. But I am not quite sure whether this classification is justifiable.

Fig. XV. *a* and *b*, *Monoblepharis brachyandra*, *c*, *Monoplepharis polymorpha* var. *macrandra*.

30. *Monoblepharis polymorpha* Cornu; Cornu 1872, p. 83.

β. *macrandra* Lagerheim; Fig. XV, c; Lagerheim 1900, p. 85.

The zoosporangia are terminal and intercalar, the oogonia are ellipsoidal, fairly symmetrical, placed side by side or in rows; the antheridia are intercalar, epigynous or remote from the oogonia.

According to Lagerheim this form differs from the main species in having intercalar zoosporangia, provided with a very long apical tube, in not having epigyne antheridia and in having oospores with originally colourless, later on tawny coloured warts.

I have found it in six localities on different species of trees in North Sealand.

31. *Monoblepharis brachyandra* Lagerheim; Fig. XV, a and b.

Lagerheim 1900, p. 37.

The oogonia, which are placed in rows, are generally asymmetrical and not ellipsoidal as in *Monoblepharis polymorpha* β *macrandra*. The antheridia are epigynous; the warts of the zoospores are from the first coloured.

In nature I have found this species twice in Sealand in the fertilizing stage.

I have found vegetative mycelium (partly provided with sporangia), probably belonging to species of *Monoblepharis* in 6 localities in North Sealand.

Micro-Oomycetes

(or Micro-Zygomycetes).

[***Chytridineae*** Fischer.]

I. ***Lagenidiineae.***

Zoospores with two flagella.

Fam. **Lagenidiaceae.**

The body of the fungus is mycelium-shaped, formed by concatenate zoosporangia or sexual cells except where we have to do with dwarfish specimens.

Lagenidium Schenk.

32. *Lagenidium Rabenhorstii* Zopf.

Zopf 1878, p. 77, 1884, p. 145.

No doubt common. Found in 7 localities (in North Sealand and Jutland).

33. *Lagenidium Zopfii* de Wildeman Fig. XVI, b. Bull. Soc. belge de Microscopie 1892, p. 139.

I have identified a form which I found in a species of *Oedogonium* at the shore of Lyng Sö, Silkeborg, Jutland (June 12th, 1909), with this imperfectly defined species. The mycelium of this form is somewhat broader than that of *Lagenidium Rabenhorstii*, and it is not so branched. As contradistinguished from *Lagenidium Rabenhorstii* the mycelium is capable of penetrating two cells, which circumstance probably takes place when the zoospore penetrates into a cell, which is in the act of dividing such as de Wildeman (1877) observed in certain cases with regard to *Lagenidium Marchalianum*. My form very much resembles the latter, but I have not observed that my form actually perforated any partition wall in the manner which has been indicated by de Wildeman. Altogether

I am somewhat sceptical with regard to the view that this *Lagenidium Marchalianum* is really a *Lagenidium*. I have found vegetative stages only in my form.

Occasionally for instance in lake Vejle Sö, near Holte (in September, 1902) I have found Lagenidium-shaped forms in *Oedogonium*, but generally in such small numbers that I dare not give any conclusive result.

34. *Lagenidium entophytum* (Pringsheim) Zopf; Fig. XVI, c. Pringsheim 1857, p. 289, Zopf 1884, p. 154.

Several localities in Sealand and Jutland.

35. *Lagenidium pygmaeum* Zopf. Zopf 1888, p. 20.

As distinct from the preceding species, which are parasites in very nutritive substrata, this species, which adheres to pollen grain which contain comparatively little nutriment, is not well developed at all. When the body of the fungus is *Lagenidium*-shaped, it is not particulary branched, but usually it is quite *Olpidium*-shaped, and in that case it is difficult to distinguish it from the Olpidiums which attack pollen-grains.

In pollen-grains of different plants.

Several localities in Sealand and Jutland.

In a *Closterium* from a pond in Höjbjaerg (September 10th, 1902) I found a Lagenidium-shaped form, which probably may be referred to the *Lagenidium Closterii* de Wildem.

Myzocytium Schenk.

Main characters similar to those of *Lagenidium*, but the single points are shorter and broader, unbranched in *M. proliferum;* in *M. irregulare* they must be considered as branched.

36. *Myzocytium proliferum* Schenk. Fig. XVI, e. Schenk 1858, p. 10; Zopf 1884, p. 159.

Certain forms which occur in the *Desmidiaceae* are generally referred to this species, though they differ from the typical *M. proliferum* in many respects. This remark especially applies to the forms in the broad *Desmidiaceae*, in certain species of the *Cosmarium*, etc. and not to those which may occur in *Closterium*, etc. Setting aside the fact that these forms are generally provided with a small number of links (generally 2) they are distinguished by the irregular forms of these links and by the fact that the tubes are different in shape. It is however unnecessary to attach any importance to this last fact, the nature of the membrane in the host-Desmidiaceae being of importance in this respect. But even the form of the links bears in my opinion sufficient testimony to the view that these forms are referable to another species[1]). In my opinion *Myzocytium*

[1]) This species which Sorokine (Revue myc. 1889) has referred to *Bicricium* may probably be referred to *Myzocytium*, but as far as I can see, there are no certain proofs with regard to this fact. At any rate the forms which have been found here in Denmark in the broad Desmidiaceae differ greatly from the forms of Sorokine.

proliferum ought only to comprise forms, the separate links of which are comparatively regular, and which, when they occur connected, form a straight line, in other words, the forms which occur in thread-algae and the elongated *Desmidiaceae*. The small forms of *Myzocytium* in the small, broad *Desmidiaceae* are, in my opinion, dwarfish forms of a species *M. irregulare*, which only occur typically in the larger broad Desmidiaceae, and which there show evident signs of the irregularities which appear in the tiny forms which occur in the small Desmidiaceae.

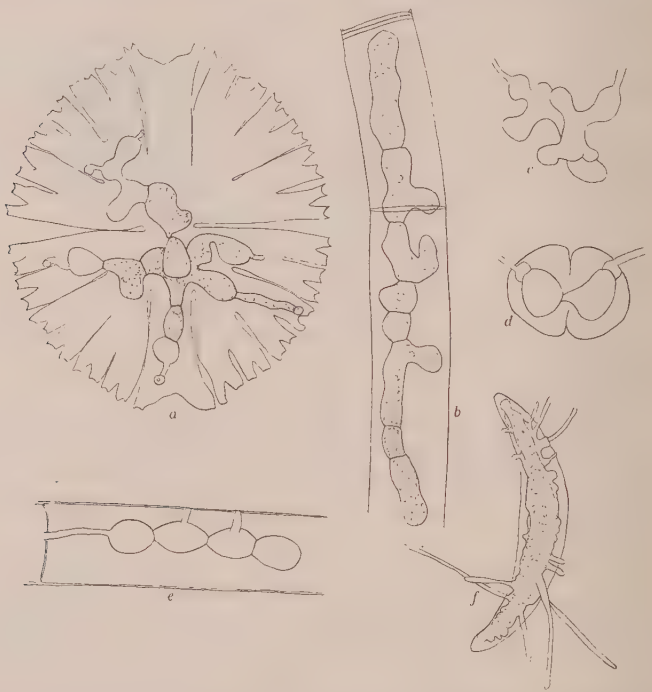

Fig. XVI. *a, Myzocytium irregulare* in Micrasterias, *d,* in Cosmarium; *b, Lagenidium Zopfii*; *c, Lagenidium entophytum* (the membrane of the host not shown); *e, Myzocytium proliferum* in Mougeotia; *f, Ancylistes Closterii.*

Very common.

37. *Myzocytium irregulare* sp. nov. Fig. XVI, a and d.

Syn. *Myzocytium proliferum* Schenk ex p.

Zoosporangia irregularia saepissime duo, rarissime plura (in Desmidiaceis, latioribus), irregulariter conjuncta; colla plus minus longa, in quoque sporangio singulum, saepe intra membranam hospitis inflatum. Characteres alii ut in *M. prolifero;* in Desmidiaceis latis, Cosmariis et al.

To this species I refer all the forms which I found in the Desmidiaceae, (with the exception of those which Sorokine has referred to *Bicricium)* the separate links of which are irregular and do not touch each other.

Most common are the individuals consisting of two links in the forms of *Cosmarium*. I have only once seen the typical form in a large *Micrasterias* (Fig. XVI, a).

The referring of this form to *Myzocytium* is probably doubtful. Perhaps it would have been better to establish a new genus or to refer these to *Lagenidium*.

The small form very common.

Fam. **Pseudolpidiaceae.**

The zoospore grows into a sporangium or a sexual cell. In the case of two adjacent sexual cells, the one changes into antheridium, the other into oogonium. In the *Olpidiopsis*, the resting-spore is an oospore, and in the *Pseudolpidium* it is produced by a particular development of a sporange-origin.

Olpidiopsis (Cornu) Fischer excl. Olp. Schenkiana.

The resting-spore is an oospore.

38. *Olpidiopsis Saprolegniae* (Cornu) Fischer; Fig. XVIII, b. Cornu 1872, p. 145; Fischer 1892, p. 38.

The zoosporangia are very differently formed, rounded with 1—3 tubes, the resting-spore is warty and has 1—2 antheridial cells. We can only define the sporangia of *Olpidiopsis* and *Pseudolpidium*, which are very common at the end of the hyphae of *Saprolegnia* (and *Achlya*), in cases where the resting-spores are present. But this rarely appears to be the case. Thus I have only found resting-spores of *Olpidiopsis Saprolegniae* three times.

Fig. XVII. *Olpidiopsis Aphanomycis.*

Vegetative stages probably very common.

39. *Olpidiopsis Aphanomycis* Cornu. Fig. XVII. Cornu 1872, p. 148.

The sporangia which Cornu has delineated in Annal. des sc. nat. 5e Sér. XV, pl IV, figs. 5—11, are very common in the mycelium of *Aphanomyces*, which is commonly found in the tegumenta of the nymphae of the Phryganeae. I dare not pronounce any conclusive verdict with regard to the number of genera and species to which these sporangia are referable; only once have I met with a resting-spore provided with two antheridial cells. This resting-spore was similar to the corresponding one in *Olpidiopsis Saprolegniae*, but it was smaller, about 16 μ in diameter; hence I do not hesitate to assert that there is at least one *Olpidiopsis* on these tegumenta. I found this view entirely upon this resting-spore. I have not succeeded in observing any emerging of the zoospore. It is just possible that in the present

case we have to do with *Olpidiopsis Saprolegniae*, which has become so small simply on account of the restricted space.

40. *Olpidiopsis (?) echinata* spec. nov. Fig. XVIII, a.

Zoosporangia ut in Olpidiopside vel Pseudolpidio Saprolegniae, diam. circ. 90—100 × 67 μ, collo singulo vel binis ternis munita. Zoosporae non visae. Sporae perdurantes diam. circ. 28—67 μ, ex actu sexuali ut in

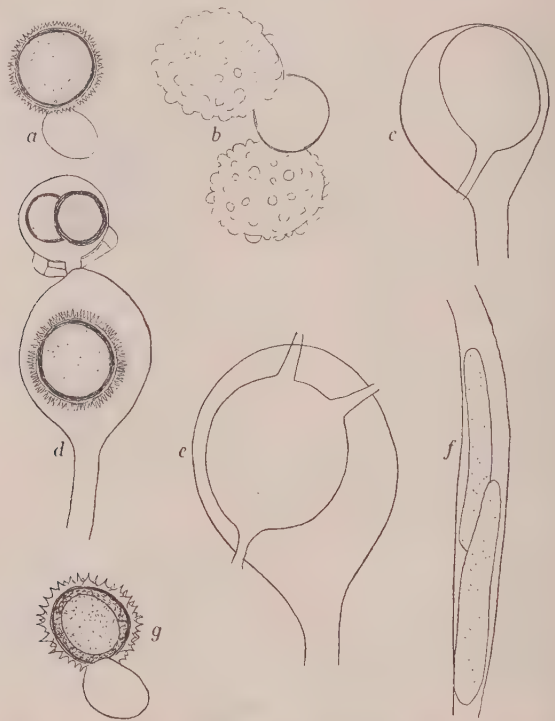

Fig. XVIII. *a, Olpidiopsis echinata*, oogonium with antheridial cell; *b, Olpidiopsis Saprolegniae*, two oogonia with one antheridial cell; *g, Olpidiopsis minor*, oogonium with antheridial cell; *c* and *e*, zoosporangia of parasites in Saprolegniacean hyphae; *d, Pseudolpidium Saprolegniae* in Achlya racemosa, *f, Pseudolpidium fusiforme*.

Olpidiopside gignuntur. Cellulae antheridiales 1—2, diam. circ. 22 μ, membrana hyalina levi instructae; oogoniales plus minus globosae, in stadio maturitatis spinis conicis plus minus evolutis (2—3 μ longis), hyalinis, dense munitae. In apicibus hypharum spec. Saprolegniae (Sap. dioicae et monoicae).

In some cases the sporangia which occur at the end of the hyphae of the *Saprolegniae*, have proved to be referable to this species, which owing to my ignorance as to the number of the flagella of the zoospores,

I temporarily refer to the genus *Olpidiopsis*. The spikes on the membrane of the oogonium are in this species much smaller and more serried than in *Olpidiopsis minor*.

Several localities in North Sealand.

41. *Olpidiopsis minor* A. Fischer. Fig. XVIII, g.

According to Fischer, this species seems to occur in species of *Achlya*, and in contrast to the species of *Olpidiopsis* (and *Pseudolpidium*) which occur in *Saprolegnia* they seem to thrive especially in the middle parts of the hyphae and not at the ends. The zoosporangia are small and globose and the oospores are set with hyaline, conical spikes, which are of a considerable size. According to Fischer they are most often found together with *Pseudolpidium fusiforme*. I have only once observed the resting-spores of this species.

Pond with Fontinalis in the wood of Böndernes Hegn near Bagsvaerd (in October 1907) in *Achlya* on a branch of *Sambucus* (together with *Pseudolpidium fusiforme*).

Pseudolpidium A. Fischer. In contradiction to *Olpidiopsis* the resting-spore is here formed without any process of fertilization.

42. *Pseudolpidium Saprolegniae* (A. Braun) Fischer; Fig. XVIII, d. Braun 1855, p. 61; Fischer 1882 and 1892, pp. 34—35.

Syn. *Pseudolpidium incrassatum* Cornu.

In the hyphae of *Achlya* I have but once found sporangia and resting-spores of a *Pseudolpidium*-shaped fungus, which was very similar to *Pseudolpidium Saprolegniae*. In my opinion, there is no reason why these two forms on *Saprolegnia* and *Achlya* should be kept separate and I identify *Pseudolpidium incrassatum* Cornu — for it is just possible that I have had to do with this form in the above-mentioned case — with *Pseudolpidium Saprolegniae*. It is the only case where I have succeeded in identifying this species. No doubt it is common.

Water pool in the wood of Store Dyrehave in *Achlya racemosa* (on May 24th, 1901).

43. *Pseudolpidium fusiforme* (Cornu) A. Fischer, Fig. XVIII, f.

Cornu 1872, p. 147; Fischer 1882 and 1892, p. 35.

Syn. *Olpidiopsis fusiformis* Cornu ex p. and *Olpidiopsis fusiformis* A. Fischer.

In contradistinction to the other parasites of this group, which occur in the *Saprolegniaceae*, this species occurs throughout the whole length of the hyphae. The zoosporangia are often cylindrically elongated, the resting sporangia are characterized as having the same size and shape as the zoosporangia, but I have not personally observed them. In *Achlya*-species in several local. in north Sealand and Jutland.

Ancylistineae.

Fam. **Ancylistaceae.**

Ancylistes Pfitzer.

44. *Ancylistes Closterii* Pfitzer. Fig. XVI, f. Pfitzer 1872, p. 379.

No doubt the *Ancylistes Closterii* is related to the *Lagenidium*. If we derive the *Lagenidiineae* from *Pythium* (and most investigators agree as to this), it would in my opinion be more natural to derive this group from the zoospore-bearing genera of *Pythium*, and *Ancylistes* from forms in which there are no traces of zoospores, cases which are to be found within this genus. That is why I judge it natural to make this group coordinate with the other groups, which are mentioned here. This species occurs in the different species of *Closterium*; evidently it is common in Denmark.

Euchytridineae.

Zoospore with one flagellum. When the mycelium is present, it is generally in the form of rhizoids.

Fam. **Cladochytriaceae.**

Within this genus the body of the fungus is formed by a system of rhizoids (mycelium) on which many sporange-origins for zoospores and resting-spores are formed, small swellings of the rhizoids. These become quite mycelium-shaped in the parts near the sporangia. Compared with the other *Euchytridineae*, the species of this family occupy a high place in vegetative respect, and therefore it is natural to begin with this family in a treatise in which the classical hypothesis of reduction is the dominant principle. Among the forms which are closely related to *Cladochytriaceae*, the genera *Catenaria* and *Nowakowskiella* occupy if possible a still higher place owing to their more abundant development of mycelium with distinct membranes. But as they have not been found in Denmark, it is out of the question to deal with them here. The genus *Hypochytrium*, regarded by Fischer as the last link within the group of *Chytridineae*, is in my opinion no genuine *Chytridinean*; it is referable elsewhere, perhaps to the Coenomycetes.

Cladochytrium (Nowakowski) de Bary.

Several sporange-origins on the same system of rhizoids. Each of these has several rhizoids, radiating in several directions. No fructification.

45. *Cladochytrium tenue* Nowakowski.

Nowakowski 1876, p. 92; Fig. XX, a.

I believe, I have found this species in old leaf-stalks of *Nymphaea* in the swamp of Böllemosen (September 18th, 1902).

46. *Cladochytrium Myriophylli* Rostrup; Mykol. Meddelelser IX; Botanisk Tidsskrift; Bd. 26, H 3, 1905, pp. 305 and 316.

This species has been investigated quite recently by C. Ferdinandsen and Ö. Winge (1909), and I refer my readers to their paper. In swellings of stems and in leaf-ridges in the species of *Myriophyllum*.

Four localities in Denmark.

Fam. **Chytridiaceae.**

In this family the mycelium or the rhizoids form the resting sporangia in the parts which are remote from the zoosporangia. This family only consists of one genus: *Chytridium* (parasite on algae), which is formed as follows: the zoosporangia are placed extramatrically, while the resting sporangia are formed intramatrically on a system of rhizoids which no doubt is mycelium-shaped (cf. Serbinow 1907, Tab. 5, Figs. 9 and 10). Owing to the resting-spores being formed in this way, this family stands somewhat isolated; it is just possible, that there may be a certain resemblance to the *Cladochytriaceae* with regard to this power of forming sporangia (though certainly of a different nature) on different parts of a system of rhizoids. The more or less mycelium-shaped rhizoids seem also to assign a higher place to this genus.

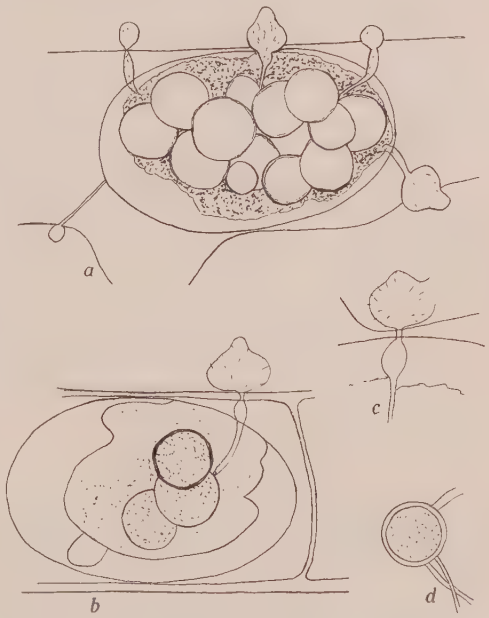

Fig. XIX. *Chytridium spinulosum*, *a* and *b*, zoosporangia and resting-spores (intramatrically), *c*, an open zoosporangium; *d*, a resting-spore in connection with mycelium.

Chytridium (A. Braun) A. Braun.

48. *Chytridium Olla* A. Braun. A. Braun 1855, p. 23.

This parasite on the oospores of the Oedogonium seems to be common.

Several localities in north Sealand and Jutland.

49. *Chytridium spinulosum* A. Blytt; Fig. XIX. Blytt 1882, page 27.

The characters of this species are similar to those of *Chytridium Olla*, but the zoosporangia are largely bottle-shaped and slightly spiked and open with an irregular, lateral orifice. I have only observed this most beautiful Chytridinean (August 28th, 1902), in a marsh near Rostgaards Steen in the wood of Danstrup Hegn. It was found within the zygospores of a big species of *Spirogyra* which was abundant along the banks among species of Carex, etc. I have not succeeded in finding this species later.

I visited this locality on August, 13th, 1903, but the *Spirogyra* seemed to have vanished entirely. Later on I have found traces of the *Spirogyra*, but the parasite was not present.

Fam. **Rhizophlyctaceae.**

Single sporangia more or less mycelium-shaped; rhizoids radiate from the sporangia or from their basal parts in all directions; no fructification *(Rhizophlyctis?)* or fructification present *(Polyphagus, Sporophlyctis)*.

Polyphagus Nowakowski.

47. *Polyphagus Euglenae* Nowakowski; Nowakowski 1876, p. 203.

Dangeard has fully dealt with this species in „Le Botaniste 7ième Série 1901, p. 213". I refer my readers to that paper.

Localities: Ditch near Roskilde Landevej (on March 23rd, April 24th, May 25th and July 1902: zoosporangia and resting-spores) and ditch close to the railway-station in Lilleröd (August, 1902).

The first named ditch has an afflux of waste-water from a kitchen, a wash-house, and a dairy-farm. The individuals of *Euglena* in both localities covered the water or rather the mud with a thick carpet. According to Dangeard the spots in which the *Polyphagus* occurred had a rusty-red colour.

Rhizophlyctis A. Fischer; Sporophlyctis Serbinow?

In a swamp near Gammel Laven (Jutland), I have found on *Draparnaldia* an individual of a fungus, which may possibly be referred to one of the above-named genera (Fig. XX, b).

Entophlyctis A. Fischer (excl. E. intestina).

All the species belonging to this genus are endophytic, and all have rhizoids arising from several points of the sporangium. Yet in this respect there is a difference within the different species. *Entophlyctis Cienkowskiana* is quite *Polyphagus*-shaped with regard to its system of rhizoids, while the rhizoids in *Entophlyctis Vaucheriae* only arise from the bottom of the sporangium. This species forms a transitional stage to, for instance, the forms of *Phlyctochytrium*, where the rhizoids arise from a single point.

In this genus the zoospore-membrane either remains connected with the sporangium itself, and in this case the latter is just under the membrane of the host-cell *(Entophlyctis bulligera)*, or it sends a fertilizing thread into the host-cell, on which the sporangium then is formed. In the latter case this organ is isolated without any connection with the zoospore, and then a special tube must be formed for the zoospores. In the forms of the first-named type, the remaining part of the zoospore serves as a tube. The resting sporangia are formed on the sporange-origins without any fructification.

50. *Entophlyctis*[1]) *heliomorpha* (Dangeard) A. Fischer; Fig. XX, c and d. Dangeard 1888, p. 143; A. Fischer 1892, p. 118.

Syn. *Chytridium heliomorphum* Dangeard.

In this species, which occurs as a parasite on the species of *Characeae* and *Vaucheriae*, the zoospore forms a fertilizing thread and the sporangia occur isolated in the host without any connection with the zoospore which soon disappears. Rather few and scarcely branched rhizoids.

General loc. in north Sealand in Characeae.

51. *Entophlyctis Vaucheriae* (Fisch) A. Fischer; Fig. XXII, c, e, f.

Syn. *Entophlyctis Spirogyrae* Fisch.?, Fisch 1884, p. 26; A. Fischer 1892, p. 117.

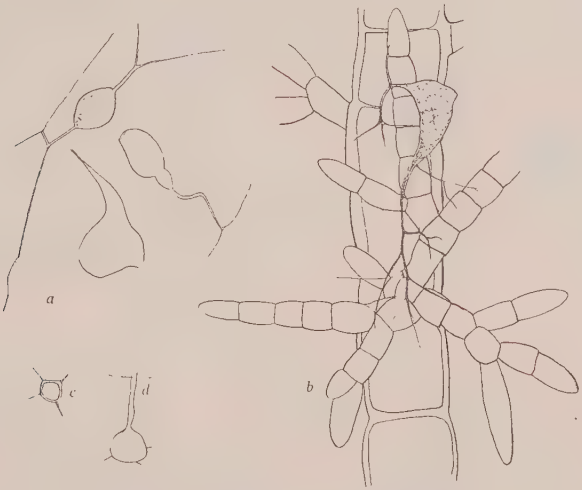

Fig. XX. *a*, *Cladochytrium tenue*; *b*, *Rhizophlyctis* sp. in Draparnaldia sp.; *c* and *d*, resting-spore and zoosporangium of *Entophlyctis heliomorpha*.

According to Fisch and Fischer, the rhizoids of this species only arise from a single point. Personally I observed this phenomenon too, but I believe I have also observed that the rhizoids may arise from several points of the basal part of the sporangia. If this is right then this species is a genuine *Entophlyctis*; on the other hand, if I am mistaken, it ought not be referred to this genus which I have restricted to forms with rhizoids which arise from various points. No doubt it is related to the other species of this genus, and it may not be incorrect to refer it to this group.

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[1]) *Entophlyctis bulligera* most probably is to be referred to the genus *Entophlyctis*, but should be assigned a different section from *Entophlyctis heliomorpha* and *Vaucheriae*. *Entophlyctis glomerata* Cienk. drawn by Sorokine in „Archives bot. du Nord de la France", T. II, p 32, lies on the border line between the two sections.

The zoosporangia of this species are more or less globular and piriform with a long tube which is not connected with the zoospore (as distinct from the section, to which *Entophlyctis bulligera* belongs). The globose resting-sporangia are formed on the same part as the zoosporangia.

In two loc. in north Sealand.

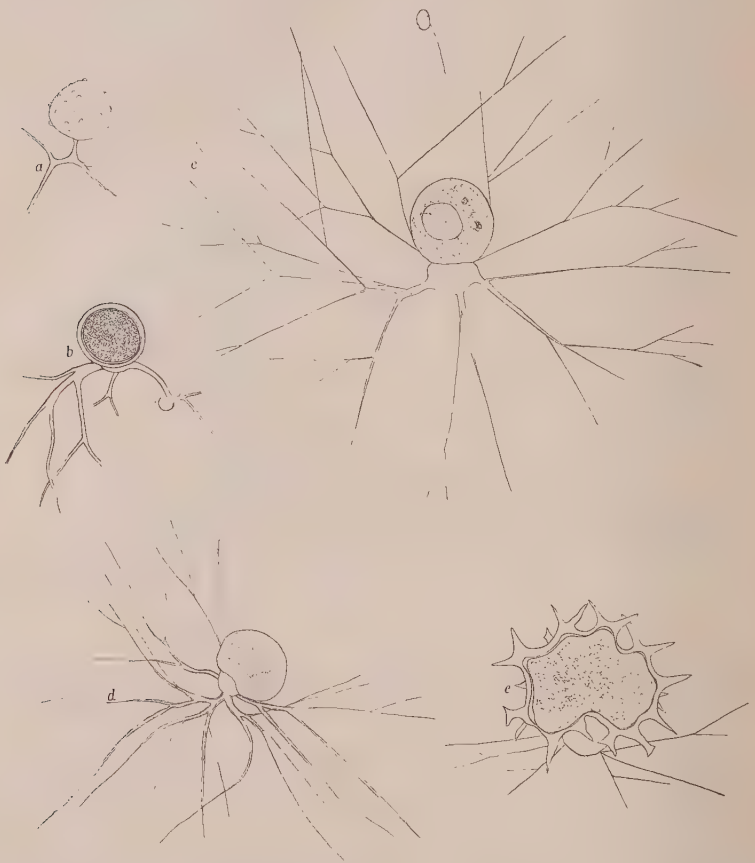

Fig. XXI. *a*, Indeterminate Chytridinean in putrid wood; *b* and *d*, *Siphonaria variabilis*, *b*, the act of copulation; *c*, *Rhizoclosmatium globosum*; *e*, *Asterophlyctis sarcoptoides*.

Fam. **Rhizidiaceae.**

I name this family after *Rhizidium mycophilum* A. Braun; it has nothing to do with the genus *Rhizidium* in Fischer's Kryptogamenflora. As demonstrated by Schroeter, the name of *Rhizidium* ought to be restricted, so that it only comprises the old species of A. Braun. A common character of this family is that the system of rhizoid-mycelium arises from a single

point in the zoosporangium. As the group which I am now going to deal with forms a unity, I have preferred to comprise the species referring thereto in one family, and then subdivide this into sub-families, rather than present a number of families.

Sub-Fam. **Siphonarieae.**

Saprophytes. The zoospore grows into a zoosporangium. The rhizoids arise close together from the basal part of the zoosporangium. No sub-sporangial enlargement. Fructification? in the Siphonaria.

Obelidium Nowakowski.

52. *Obelidium mucronatum* Nowakowski. Nowakowski 1876, p. 86.

In this species the lower part of the sporangium has an elongation, from the base of which the rhizoids arise. The sporangium itself is oval-elliptic, and the membrane at the top tapers into a spine. The zoospore emerges through an orifice at the side of the sporangium.

I have only observed this species twice in single specimens, so I have not been able to affirm whether Nowakowski's curious statement as to the zoospores being devoid of flagella, is correct.

Loc. On tegumenta of the nymphae of the Phryganeae: the lake of Fure Sö (3. 9. 01); the swamp of Tibirke (25. 5. 03).

Siphonaria H. E. Petersen.

The lower part of the sporangium is papillate to a certain degree. The rhizoids arise from one side of the papilla.

53. *Siphonaria variabilis* H. E. Petersen. Fig. XXI, b, d. Petersen 1903, p. 220.

The zoosporangia are different in shape and size, globose, more or less extended in length with great papilla, kidney-shaped with a tiny papilla, often scarcely visible, with smooth and colourless membranes, about 11—24 μ in diameter. The rhizoids arise from the side of the papilla or if it is very small from the sporangium itself. The rhizoids are much branched, and their membranes[1]) are visible in the part nearest the sporangium. As far as I can see, the zoospores (1—3 μ in diameter) have but a single flagellum; very often they contain a rusty-red body (a nucleolus?). They escape through an orifice in the papilla or in the corresponding region in the forms, which have a small papilla, near the arising-point of the rhizoids. The resting-sporangia are more or less globose; they are formed by a sort of fertilization-process between two individuals,

[1]) I have not been able to trace a membrane in the outer parts of the rhizoids. All the rhizoids which have no distinct membranes are no doubt provided with a thin pellicule. The fact that the protoplasm in the rhizoids occurs in isolated masses, placed side by side, seems to favour this theory. Yet this fact may be interpreted in quite a different way.

which are close together (fig. XXI, b). A rhizoid-thread from a sporangium fuses with a similar thread from another, and this fusion having taken place, the one sporangium is checked in its growth and loses all its contents, while on the other hand the other sporangium becomes vigorous and surrounds itself with a thick (brown) membrane. Owing to the lack of proper material, I have not been able to trace the cytological circumstances of this process, which resembles rather a kind of devouring of the one individual than any process of fertilization. This species is common on tegumenta of the nymphae of the Phryganeae.

Sub.-Fam. **Diplophlycteae.**

Between the sporangium and the rhizoids appears a subsporangial enlargement which is as yet not distinctly separated from the sporangium, and which passes into the rhizoids. The sporangium does not arise from the zoospore.

54. **Diplophlyctis** Schroeter.

Diplophlyctis intestina (Schenk) Schroeter. Schenk 1858; Schroeter 1892, p. 78.

Syn. *Rhizidium intestinum* Schenk l. c.; Zopf 1888, p. 191.

This form occurs as a parasite on the species of *Characeae*, and is endophytic; consequently the zoosporangium does not correspond to the zoospore. The zoospore germinates on the outside of the host-cell and sends in a fertilizing thread, on which the sporangium is formed. The resting sporangia are spiked and are formed without actual fertilization on the same part as the zoosporangia.

Several localities in north Sealand and Jutland.

Sub.-Fam. **Rhizoclosmatieae.**

The sporangia have a subsporangial part which is entirely distinct from the sporangium and is to be looked upon as an enlargement of the base of the rhizoids. The sporangium arises directly from the zoospore.

Rhizoclosmatium H. E. Petersen.

The subsporangial part which keeps its rhizoid-shaped contents for a long time, has much in common with the rhizoids. The zoospores escape through an orifice in the membrane of the sporangium.

55. *Rhizoclosmatium globosum* H. E. Petersen; Fig. XXI, c. H. E. Petersen 1903, p. 216.

The zoosporangia are globose, about 17—20 μ in diameter and have a colourless, smooth membrane. The plexus of the rhizoids is often much branched and then covers an area which is considerable in proportion to the size of the sporangium. Below the sporangium the rhizoids gather into a subsporangial part which is quite rhizoid-shaped. The zoospores (2—3 μ in diameter) escape one at a time through a round orifice in the

membrane of the sporangium. A long flagellum attached to the one side, points backwards, and they are often provided with a nucleolus of a rusty-red colour. The resting sporangia are formed on the same part as the zoosporangia; they have the same shape and size as these, and the membrane is thick and brownish in colour. Common on the tegumenta of the nymphae of the Phryganeae. The resting-spores occur fairly frequently and are already formed in early summer.

Asterophlyctis H. E. Petersen,

This genus has much in common with *Rhizoclosmatium*, but differs from it in the fact that the subsporangial part is more separated from the rhizoids and cannot altogether be considered as an enlargement of these, in that it early loses its primary contents and furthermore, as the zoospores escape through an orifice in the subsporangial part, or near it.

56. *Asterophlyctis sarcoptoides* H. E. Petersen. Fig. XXI, e. H. E. Petersen 1903, p. 218.

Usually the fully developed sporangia have a very thick membrane with thorny spikes; in a few cases the membrane seems to be thin and the spikes are formed by a kind of protuberance. The sporangia of the last-named forms seem to remain at a rather primitive stage, for, judging from the stages of development which I have observed, these protuberances of the interior of the cell seem to be the origin of at any rate a great number of the spikes (cf. my diagrams in Journal de Botanique 1903).

The sporange-wall, the spiked as well as the non-spiked, is colourless. The spikes may become furcated. All the zoospores escape simultaneously united in a cluster by the flagella. There is but one flagellum (at the back part). With regard to the orifice and the subsporangial parts, see above. The plexus of the rhizoids is not particularly developed. I have not observed any resting sporangia. This species is not rarely found on the tegumenta of the nymphae of the Phryganeae.

Sub.-Fam. **Phlyctochytrieae.**

The species which are referred to this family are epiphytic-endophytic parasites with one part of the sporangium on the outside, and the remaining part within the membrane of the host-cell. The part which is on the outside is directly derived from the zoospore. This part develops into the real zoosporangium. It is only in *Phlyct. stellatum* that the internal part has this function. The rhizoids arise from the sporangial part either from the zoosporangium itself, if this latter is intramatrical or from the intramatrical elongation of the zoosporangium, generally from a single point with an at first undivided main trunk. Fertilization rarely occurs within the group (*Zygorhizidium*). The resting-spores are formed either by the extra-or by the intramatrical part of this sporangium.

Phlyctochytrium Schroeter[1]).

This generic name has been introduced by Schroeter instead of *Rhizidium*, which according to this author is only applicable to a single species, *Rhizidium mycophilum*, which belongs to quite another group.

The intramatrical part is globose only serving as zoosporangium in *Phlyctochytrium stellatum*. In the last named species, and in the first and entirely vegetative stages in the other species, this part is much larger than the extramatrical part. The resting spore is formed by the intra-or extramatrical part of the sporangium.

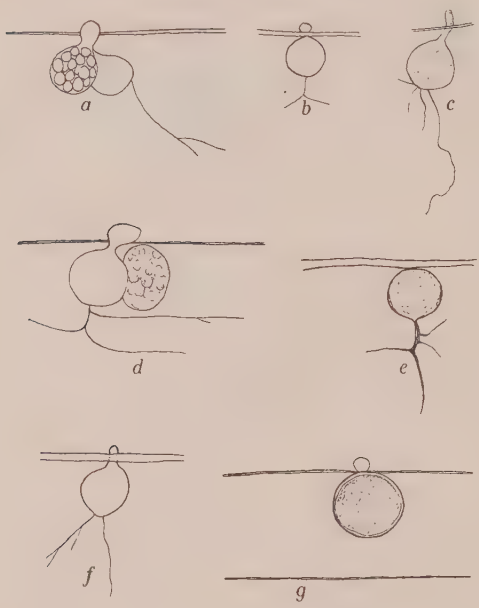

Fig. XXII. *a*, *b* and *d*, *Phlytochytrium stellatum*, in *a* and *d* the vesicle with the ripe zoospores are seen; *c*, *e* and *f*, *Entophlyctis Vaucheriae*; *g*, resting sporangium of *Phlyctochytrium Schenkii*.

57. *Phlyctochytrium Schenkii* (Dangeard) Schroeter; Fig. XXII, g. Dangeard 1886, p. 297; Schroeter 1892, p. 78.

The zoosporangia are extramatrical, of different and irregular shape, sometimes erect, sometimes along the membrane of the host-cell without any fixed position of the orifice for the zoospores. The resting-spores are formed by the intramatrical part of the zoospore. The membrane is thick, smooth and colourless with extremely oily contents. Fig. XXII, g.

It occurs as a parasite on *Oedogonium* and other species of algae, for instance, *Bulbochaete*, *Spirogyra* and *Closterium*.

Very common. Most often found at the characteristic vegetative stage (cf. Fig. XXII b, drawn from *Phlyctochytrium stellatum*, but it may also serve as a model for *Phlyctochytrium Schenkii*). Resting-spores seem to be sparingly formed.

58. *Phlyctochytrium stellatum* sp. nov.; Fig. XXII, a b d. Fig. XXIII.

Habitus in stadio vegetativo ut in *Phlyctochytrio Schenkii*; zoosporangia ex parte intramatricali oriuntur. Zoosporis formantibus zoosporangia tu-

[1]) No doubt we ought to establish different genera or at any rate sections within this family, according to whether the zoosporangium and the resting sporangium are formed by the extra-or intramatrical part or by both.

mescent et vesicam lateralem procreant. Zoosporae per orificium prope partem extramatricalem vel per hanc ipsam liberatae sunt. Zoosporae non examinatae. Membrana zoosporangii hyalina, levis. Sporae (angia) perdurantes (ia), singulae (a), membrana echinata, hyalina instructa, in parte intramatricali oriuntur.

As mentioned above the vegetative stage of this species is similar to that of *Phlyctochytrium Schenkii*. I am not quite sure whether I have had to deal with quite normal individuals; but in my opinion the coming out of the zoospore was so peculiar that I feel somewhat doubtful whether my observations on this point are correct. In individuals from the two localities from which I obtained this form, I observed fairly often that a vesicle was formed laterally on the subsporangial part and that the contents of the fungus passed into it. This vesicle then discharged the zoospores through an orifice, which had been formed in the primary zoosporangium close to the point where the extramatrical part passes into the intramatrical part. In my opinion, an attack from parasites is not possible. I have not had an opportunity of investigating the zoospores. The resting-spores or the sporangia are formed on the same place as the zoosporangia. They are globose with spiked, colourless membrane (Fig. XXIII). The spikes gradually grow out, coincident with the ripening of the zoospores.

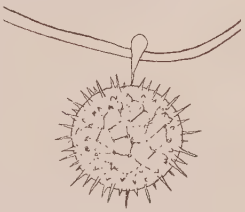

Fig. XXIII. *Phlyctochytrium stellatum*, resting-spore (sporangium).

This species occurred in rather great numbers of individuals, in a large species of *Spirogyra* together with *Chytridium spinulosum* along the banks of the pond of Rostgaards Dam in the wood of Danstrup Hegn (July 28th, 1902). I have observed it in smaller numbers (in a similar species of *Spirogyra*), in a pond near the wood of Stavnsholt, September 5th, 1902.

Sub-Fam. **Rhizophidieae.**

The genera referred to this sub-family are devoid of an intramatrical sporangial part, they consist of two parts: an extramatrical zoosporangium and an intramatrical rhizoidal part. The resting-sporangia are formed in the same place as the zoosporangia.

Rhizophidium (A. Schenk) A. Fischer[1]).

As to the description of *Rhizophidium decipiens*, see *Olpidium decipiens*.

59. *Rhizophidium pollinis* (A. Braun) Zopf; Fig. XXIV e. A. Braun 1855 p. 40; Zopf 1887, p. 6.

Very common everywhere on the pollen grain of different plants.

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[1]) *Rhizophidium ampullaceum* should be entirely excluded from the group of the Chytridineae. Probably it should be referred to the Infusoria.

60. *Rhizophidium globosum* (A. Braun) Schroeter; Fig. XXIV c. A. Braun 1855, p. 34; Schroeter 1886, p. 191.

The whole genus of *Rhizophidium* needs further investigation, more especially this species which has not been satisfactorily characterized and defined.

Judging from Fischer's descriptions in the Kryptogamenflora of Rabenhorst I have found this species but once, viz: on June 28th, 1903, in a water containing Nymphaea in Helgenaes on a species of Penium.

On the Desmiaceae I have observed in 3 other localities in north Sealand a few specimens of a more or less globose *Rhizophidium*, which

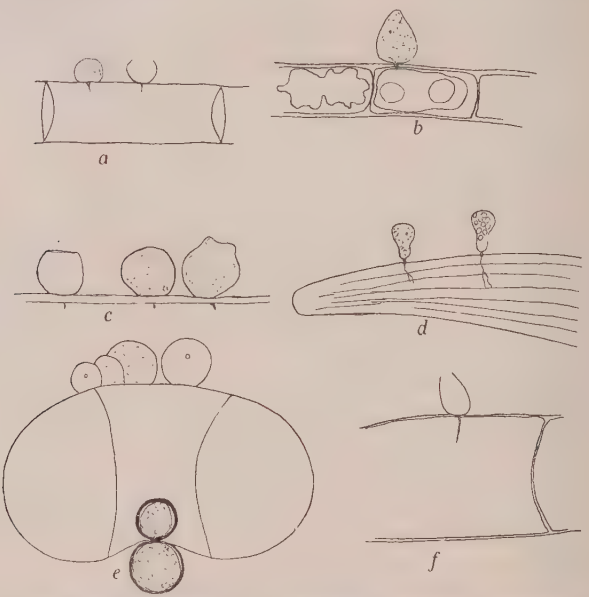

Fig. XXIV. *a, Rhizophidium sphaerocarpum; c, Rhizophidium globosum; d, Rhizophid. septocarpoides; e, Rhizophid. pollinis; b* and *f*, indeterminate *Rhizophidium* sp.

did not belong to *Rhizophidium sphaerocarpum*, and in which the escape of the zoospores took place on the upper part through a great orifice.

61. *Rhizophidium sphaerocarpum* (Zopf) A. Fischer; Fig. XXIV, a. Zopf 1884, p. 202; Fischer 1892, p. 95.

Syn. *Rhizidium sphaerocarpum* Zopf.

Several localities in north Sealand and Jutland.

62. *Rhizophidium septocarpoides* sp. nov. (Fig. XXIV, d).

Zoosporangia brevissime pedunculata, piriformia, parte basali angustiori, membrana hyalina, levi, munita, 8—16 μ longa. Mycelium intramatricale parce ramosum. Ceteri charateres ignoti. In Closteriis.

The lake of Sorte Sö in the wood of Teglstrup Hegn. (July 31th, 1902).

This species of *Rhizophidium* of which I only once found a few species resembles *Septocarpus* in the little stem inserted between the host-membrane and the sporangium.

Rhizophidium sp.

I. In a swamp at the south-east border of Hornbaek Plantage I found (in July, 1908) the exhausted sporangia of a *Rhizophidium* (Fig. XXIV, f).

II. On July 19th 1903 I observed a *Rhizophidium* sp. (fig. XXIV, b) in the lake of Ellesö, Virklund, Jutland; it appears to be related to *Rhizophidium acuforme* (Zopf) Fischer.

III. A species of *Rhizophidium* was found on *Cylindrocystis Brebissonii* (det. Kolderup Rosenvinge) in a sample of sand taken by Professor E. Warming from a valley between the dunes of Fanö. This species belonged to the group Multiporia. Sometimes the sporangium was globose, sometimes with rounded corners. No doubt this form is related to *Rhizophidium globosum*, but I dare not as yet pronounce a conclusive view with regard to this question. The occurrence of the last-named species of *Rhizophidium* is indeed most curious. Probably the sand at some time or other must have been covered with water.

Fam. **Olpidiaceae.**

No development either of the rhizoids or of the mycelium. The body of the fungus consists of a single sporangium, a zoosporangium or resting-sporangium. The latter is in most cases formed by a special development of the sporange-origin. Fertilization between two sporangia in close juxtaposition is less frequent. The zoospore is uniflagellated. This family entirely corresponds to the fam. *Pseudolpidiaceae* within the group of *Lagenidiineae.*

Diplophysa Schroeter; Schroeter 1892, p. 85.

63. *Diplophysa Schenkiana* (Zopf) Schroeter; Fig. XXV, d. Zopf 1884, p. 68; Schroeter l. c.

It is common in the *Zygnemaceae*, especially *Spirogyra*. As I have only observed the resting-spore a single time my indications are perhaps not altogether reliable.

Ectrogella Zopf.

64. *Ectrogella Bacillariacearum* Zopf; Fig. XXVI, a. Zopf 1884, p. 175.

I once found in a species of *Fragilaria* two sporangia of a fungus, which no doubt must be referred to this species. One of these sporangia had no tube, the other only one, but it resembled that of *Ectrogella*. There was no separation of the membranes of the Diatomaceae, but probably this circumstance is not common to the species.

Loc. Dark pond in a wood in the outskirts of Donse Overdrev (August 30th, 1902).

Pleotrachelus Zopf.

65. *Pleotrachelus Wildemani* sp. nov.; (Fig. XXV c).

Zoosporangia globosa diam. c. 60—80 μ, membrana levi, fusca, collis 30—40 μ longis munita. Characteres alii ignoti. In rhizinis cujusdam Musci immersi, quas tumefacit; in palude Sphagnorum in Velling Skov (Jyll), 16. 6. 03.

In my opinion the species which I have presented here cannot be identified with *Pleotrachelus radicis* de Wildeman; the latter species has a far greater number of tubes, which are much shorter than those of my species.

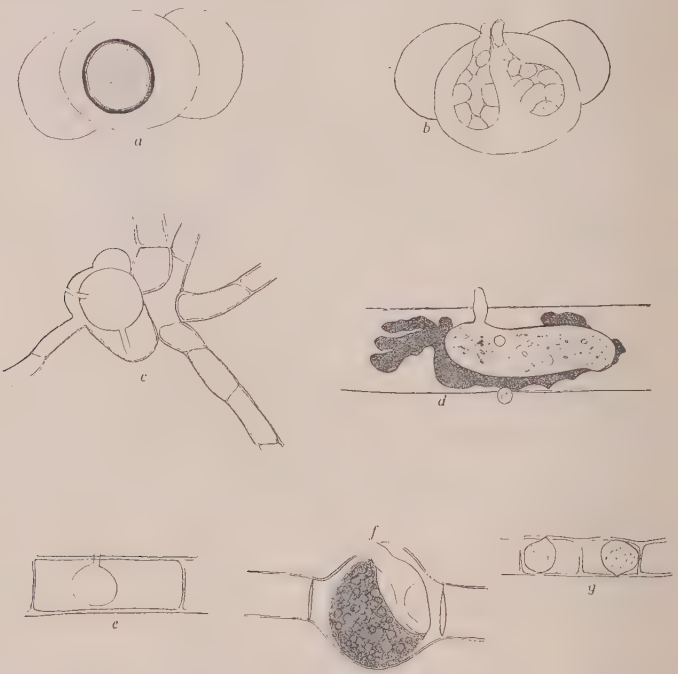

Fig. XXV. *a*, resting-spore (angium) of *Olpidium luxurians; c, Pleotrachelus Wildemani* in rhizoids of a species of moss.; *d, Diplophysa Schenkiana*, a zoosporangium; *f, Olpidium* (?) *decipiens*; *b, Olpidium* sp. in pollen; *e* and *g, Olpidium* sp. in various algae.

Olpidium A. Braun.

1—3 tubes, mostly only one.

66. *Olpidium luxurians* (Tomaschek) A. Fischer. Fig. XXV a. Tomaschek 1878, p. 204; Fischer 1892, p. 29.

In the pollen grain of conifers I have found Olpidia rather often, but as I have greatly neglected the study of these forms, I can say very little with regard to their distribution. I have noticed *Olpidium luxurians* only a few times.

67. *Olpidium gregarium* Nowakowski. Nowakowski 1876, p. 77.

I believe I have thrice found (north Sealand) two individuals of this species occurring as parasites in the eggs of lower animals, for instance, rotatoria.

68. *Olpidium (?) decipiens* (A. Braun; Fig. XXVf). A. Braun 1855, p. 54.

Syn. *Rhizophidium decipiens* (A. Braun) A. Fischer.

This parasite which occurs in the oospores of the species *Oedogonium* is probably not a *Rhizophidium*. As long as the rhizoids have not been indicated, I judge it most correct to refer this species to the genus *Olpidium*. No doubt this species will have to be referred to quite a new genus, should such organs be discovered.

The zoosporangia of this species do not perforate any membrane with tubes; they are isolated in the open oogonia of the Oedogoniaceae and open directly into the environing water by means of an elongation which they protrude through the orifice of the oogonium. Evidently the resting-spores are common, but I have not observed them with any degree of certainty. Besides, several parasites occur within the oospores of the *Oedogonium* which are liable to be mistaken for these.

Five localities in north Sealand and Jutland.

I have several times observed sporangia belonging to the genus *Olpidium*, but generally they have occurred only in a few specimens, and I have neither been able to refer them to the hitherto described species, nor felt inclined to describe new species owing to the insufficient material. Therefore I will confine myself to say that it is very possible several more than the three above named species are to be found, but no doubt their identification will involve great difficulties. Upon the whole these species need careful investigations, accompanied by experiments and carried on through many years. In my opinion the indeterminable form of *Olpidium* which I have delineated in Fig. XXV, e, is to be referred to *Olpidium entophytum* A. Braun, while it is just possible that fig. g represents a new species.

Pleolpidium A. Fischer? fig. XXVI, c, d.

Thaxter mentions in Bot. Gazette 1896, Vol. 21, p. 50 a parasite in *Blastocladia:* „Numerous plants were found bearing peculiar sporangia, proportionately much larger than the ordinary and nearly oval forms, many of which contained large well-defined rounded masses of protoplasm which at first suggested the presence of oospheres; but further examination showed them to be early conditions of the resting-spores of a species of *Rozella*, parasitic on the *Blastocladia*, which when mature became spherical, thickwalled and echinulate.

I have found the very same form in *Blastocladia* from a pond in the garden of Frederikshaab near Glostrup (cf. fig. XXVI c, d), but I must say that I do not know, why this form should be referred to *Rozella*. In my opinion it would be more correct to refer this parasite to the

genus *Pleolpidium*, and perhaps it would be still more correct to consider it as a genuine *Olpidium*. Owing to insufficient material I have not been able to supply new details with regard to this question, so I confine myself to the above remarks.

Two species of *Chytridineae* which have not yet been investigated are shown in fig. XXVI, b and e.

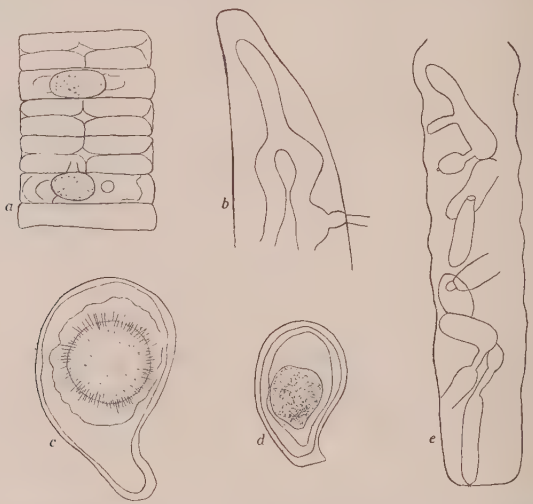

Fig. XXVI. *a, Ectrogella Bacillariacearum* in Fragilaria (?) sp.; *c* and *d, Pleolpidium* sp. (?) in Blastocladia Pringsheimii; *b* and *e*, indeterminate Chytridineae in Desmidiaceae.

Synchytridineae.

Fam. **Synchytriaceae.**

The naked mass of protoplasm which is formed by the zoospore surrounds itself with a membrane, inside which the sporange forms a sorus.

Micromyces Dangeard.

The body formed by the zoospore either grows into a resting sporangium the germination of which is not known (with a sorus of sporangia?) or it forms within itself a sorus of sporangia which comes out in a vesicle.

69. *Micromyces Zygogonii* Dangeard; Fig. XXVII, c. Dangeard 1888, p. 52.

In species of *Mougeotia.*

Several localities in north Sealand and Jutland.

Fam. **Woroninaceae.**

Woronina Cornu.

70. *Woronina polycystis* Cornu; Fig. XXVII a and b. Cornu 1872, p. 176.

Occurs as a parasite in the hyphae of *Saprolegniaceae.*

According to Cornu and Fischer this species is not parasitic on species of *Achlya.* With regard to this I may remark, that I have several times found a form on *Achlya*, which corresponded so closely to the form of *Saprolegnia* that, in my opinion, it is identical with *Woronina polycystis.* It is just possible that it is a question of a biological variety of *W. polycystis.* On the other hand another form which I observed once within a *Saprolegniacean* may be considered as a special form. In the latter the sorus of the zoosporangium was closer to the membrane than is indicated and illustrated with regard to *Woronina polycystis*, and as I observed it elsewhere. Here the zoosporangia became more angular. Further, I observed in the same host that they occurred in single rows in hyphae of a very small size and that they seemed to be quite cubical with the cross-membranes placed across the membrane of the hyphae, suggesting a ladder. Owing to this fact I gave this form the name *scalariformis.*

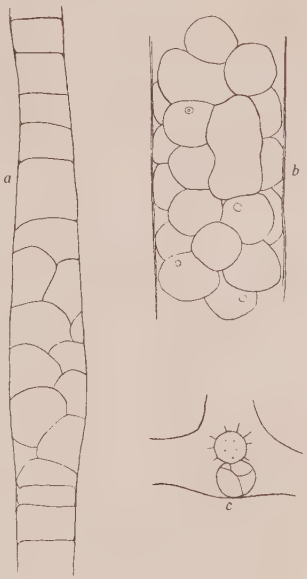

Fig. XXVII. *a* and *b*, *Woronina polycystis a*, forma scalariformis, *c*, *Micromyces Zygogonii*.

α In a few localities in north Sealand and Jutland.

β *scalariformis.* In a Saprolegniacean in the pond [Funkedam] near Hilleröd (Oct. 1902).

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Servit, M. Zur Flechtenflora Böhmens und Mährens (Hedwigia vol. L, 1910, p. 51—85).

Referate und kritische Besprechungen[1]).

Arthur, J. C. North American Rose Rusts (Torreya vol. IX, 1909, p. 21—28).

In dieser kurzen Übersicht über die nordamerikanischen Rosenroste werden außer *Phragmidium speciosum*, das in des Verfassers System als *Earlea speciosa* bezeichnet wird, sechs Arten der Gattung *Phragmidium* unterschieden, nämlich *Phr. americanum* (Pk.) Diet., *Phr. Rosae-setigerae* Diet., *Phr. Rosae-californicae* Diet., *Phr. Rosae-arkansanae* Diet., *Phr. montivagum* Arth. n. sp. und *Phr. disciflorum* (Tode) James = *Phr. subcorticium* (Schrnk.). Die letztere Art ist von Europa nach Nordamerika auf kultivierten Rosen eingeführt, die übrigen fünf sind in Amerika einheimisch und kommen nicht außerhalb dieses Erdteils vor. Das neue *Phr. montivagum* kommt vor auf *Rosa Bakeri, Fendleri, grosse-serrata, manca, Maximiliani, Sayi, Underwoodii, Woodsii* u. a.

Sehr interessant sind die Angaben des Verfassers über die geographische Verbreitung der einzelnen Arten. Die Areale derselben sind ziemlich getrennt voneinander, nur in der Mitte der Vereinigten Staaten greift der Verbreitungsbezirk des *Phr. Rosae-arkansanae* östlich in denjenigen des *Phr. Rosae-setigerae* weit über und westlich weniger weit in denjenigen des *Phr. montivagum*. Im Nordosten, von Maryland nordwärts längs der atlantischen Küste und nördlich der großen Seen tritt *Phr. americanum* auf, und im Westen längs der pazifischen Küste das *Phr. Rosae-californicae*. *Phr. speciosum* nimmt insofern eine Sonderstellung ein, als es durch die ganzen Vereinigten Staaten verbreitet ist. Bemerkenswert ist ferner ein gewisser Parallelismus zwischen der Variabilität der Arten und derjenigen ihrer Nährpflanzen. Die variabelste Art ist *Phr. montivagum*, sie bewohnt auch einen großen Kreis von Nährspezies, die zum Teil schlecht gegeneinander abgegrenzt sind. Die anderen Arten (außer *Phr. speciosum*), weniger variabel, bewohnen nur eine oder wenige nahe verwandte Spezies und haben ungefähr dieselbe Verbreitung wie ihre Nährpflanzen. Dietel (Zwickau).

[1]) Die nicht unterzeichneten Referate sind vom Herausgeber selbst abgefaßt.

Arthur, J. C. Right and wrong conceptions of plant rusts (Proceed. of the Indiana Academy of Science. XXV. Anniv. Meeting 1910, 8 pp.).

In diesem Schriftchen legt der Verfasser seine bereits anderweitig bekannt gegebenen Ansichten über die Systematik der Uredineen kurz dar, durch die er auf Grund der Länge und Art des Entwicklungsganges zu einer völlig neuen Einteilung der Gattungen gelangt. Er weist ferner darauf hin, daß es falsch ist, die Aecidio- und Uredosporen als Konidien, als ungeschlechtliche Sporen zu bezeichnen. Als solche sind außer den Basidiosporen nur die an einem einkernigen Myzel erzeugten Pyknosporen (Spermatien) anzusehen, während die übrigen Sporenformen an einem Myzel entstehen, das infolge einer Zellfusion, welche als Sexualvorgang gedeutet wird, zweikernige Zellen hat, so daß sie demgemäß als geschlechtlich erzeugte Sporen angesprochen werden. Aus diesem Grunde sollen in Nomenklaturfragen nur die etwa für die Pykniden gegebenen Namen unberücksichtigt bleiben. Dietel (Zwickau).

Bataille, F. Champignons rares on nouveaux de la Franche-Comté (Bull. Soc. Myc. France vol. XXVI, 1910, p. 138—149).

Verf. gibt eingehende Beschreibungen zu einer Anzahl zum Teil noch mangelhaft bekannter Hymenomyceten, nämlich *Amanita umbellata* Quél., *A. umbrino-lutea* Secr., *Lepiota Persoonii* (Fr.) Quél., *L. arida* (Fr.) Quél., *L. illinita* Fr., *Armillaria haematites* Berk. et Br., *Tricholoma brevipes* Fr., *T. cognatum* Fr., *T. oreinum* Fr., *Volvaria Loweiana* Berk., *Entoloma costatum*, *Cortinarius balteatus* Fr., *C. atrovirens* Krombh., *Inocybe mixtillis* Britz., *Crepidotus junquilla* Quél., *Pleurotus serotinus* Fr., *Leptoporus amorphus* (Pers.) Quél., *Poria viridans* Berk. et Br., *Radulum Kmetii* Bres., *Tulostoma fulvellum* Bres., *Hydnangium carotaecolor* Berk., sowie zu *Leotia Batailleana* Bres.

Bataille, Fr. Flore monographique des Hygrophores (Mém. Soc. d'Emulation du Doubs VIII. sér. vol. IV, 1909, 65 pp.).

Verf. gibt eine dankenswerte Zusammenstellung und Beschreibung der meisten (82) europäischen *Hygrophorus*-Arten. Die Diagnosen lassen nichts zu wünschen übrig; insbesondere berührt es angenehm, daß Verf. auch die mikroskopischen Details, wie Sporenform und Größe, stets angibt. Die Maire'sche Gattung *Godfrinia*, welche dadurch charakterisiert ist, daß die Basidien nur 2—3 Sporen tragen, wird einstweilen noch mit *Hygrophorus* vereinigt, da noch nicht alle Arten auf die Anzahl der an einer Basidie gebildeten Sporen hin genügend untersucht sind. Die von Britzelmayr aufgestellten Arten hat Verf. infolge der nicht genügenden Diagnosen dieses Autors nicht aufgenommen.

Bubák, Fr. Zwei neue, Tannennadeln bewohnende Pilze (Naturw. Zeitschr. f. Forst- und Landwirtsch. vol. VIII, 1910, p. 313—320, 5 fig.).

Verf. beschreibt zwei mit bisher bekannten nadelbewohnenden Arten nicht identifizierbare Pilze, die in einer Pykniden- und einer zweifellos dazu gehörigen Askusform an den jungen Trieben der Weißtanne beob-

achtet wurden. Die Pyknidenform wird als *Phoma bohemica*, die Askusform als neue Gattung *Rehmiellopsis* mit vielsporigen Schläuchen und wegen ihrer Zugehörigkeit zu *Phoma bohemica* als *Rehmiellopsis bohemica* beschrieben.
Schnegg (Freising).

Fawcett, H. S. An important entomogenous fungus (Mycologia vol. II, 1910, p. 164—168, tab. XXVIII—XXIX).

Der von H. J. Webber im Jahre 1896 entdeckte und in ökonomischer Hinsicht höchst wichtige, auf den Larven von *Aleyrodes Citri* und *A. nubifera* an Citrusblättern lebende Pilz, der bisher unter dem Namen „brown mealy-wing fungus" bekannt war, wird vom Verf. als *Aegerita Webberi* n. sp. ausführlich beschrieben. Die künstliche Infektion der *Aleyrodes*-Larven mit dem Pilze gelang dem Verfasser.

Ferdinandsen, C. and **Winge, O.** Fungi from prof. Warmings expedition to Venezuela and the West-Indies (Botanisk Tidsskrift vol. XXX, 1910, p. 208—222, 7 fig.).

Enthält an neuen Arten: *Helotium (Helotiella) discula*, *Sterigmatocystis dipus* auf halbfaulen *Theobroma*-Früchten, sowie die neuen Gattungen: *Myxotheca*, zu den Plectascineen gehörig, aber von zweifelhafter Stellung. Die Schläuche liegen einzeln im Stroma und sind von einer gelatinösen Substanz eingeschlossen; Sporen mauerförmig-geteilt, gefärbt. Einzige Art ist *M. hypocreoides* auf lebenden Blattfiedern von *Trichomanes pinnatum* in Trinidad.

Stilbochalara, zu den Phaeostilbeen gehörig, gleichsam eine Stilbee mit *Chalara*-artiger Konidienbildung; einzige Art ist *St. dimorpha* auf halbfaulen *Theobroma*-Früchten in Venezuela.

Keißler, K. v. Über einige Flechtenparasiten aus dem Thüringer Wald (Centralbl. f. Bact. etc. II. Abt. vol. XXVII, 1910, p. 208–215, 2 fig.).

Von neuen Pilzen wurden gefunden *Coniothyrium lichenicolum* var. *Buelliae* nov. var., an *Buellia disciformis*, dann *Sirothecium lichenicolum* var. *bisporum* nov. var. an den Apothezien von *Lecanora Hagenii*, außerdem *Didymella Lettauiana* nov. spec. auf einem mit einem Thallus *(Pharcidia?)* überzogenen Stein.
Schnegg (Freising).

Lloyd, C. G. Synopsis of the genus Hexagona (Cincinnati, Ohio, June 1910, 8°, 46 pp., fig. 276—330).

Verf. beschreibt und bildet ab 48 gültige Arten der Gattung *Hexagona*. Da Verf. von den meisten Spezies die Originale gesehen hat, so sind seine Mitteilungen, die einer monographischen Bearbeitung nahe kommen, von großem Werte. In einem Appendix führt Verf. noch 77 zu *Hexagona* gestellte Spezies auf, die teils mit anderen Arten synonym sind, teils zu *Polyporus* oder *Polystictus* gehören oder solche Arten darstellen, von denen er Belegexemplare nicht gesehen hat. Der Wert der Abhandlung wird durch die reichen und schönen Abbildungen sehr erhöht.

Maire, R. Les bases de la classification dans le genre Russula (Bull. Soc. mycol. France vol. XXVI, 1910, p. 49—126, 6 Fig.).

Die Grundlage zu einer monographischen Bearbeitung der Gattung *Russula*. Der Hauptteil der Arbeit besteht in einer kritischen Besprechung der zur Charakterisierung einer *Russula*-Art verwendbaren Merkmale. Als solche werden unterschieden:

makroskopische: Allgemeine Charaktere (z. B. Konsistenz, Geruch, Geschmack usw.), Merkmale des Stiels, des Hutes und der Lamellen.
mikroskopische: z. B. Zystiden, Basidien, Sporen, anatomische Struktur.
chemische: Farbenreaktionen.

Es folgt dann die beispielsweise Beschreibung einiger *Russula*-Arten unter Zugrundelegung obiger Merkmale, und eine tabellarische Übersicht über die Sektionen der Gattung, mit Anführung der in jede einzelne Sektion gehörigen Arten. Neger (Tharandt).

Maire, R. Les variétés méditerranéennes du Boletus impolitus Fr. (Bull. Soc. Bot. France IV. Sér. vol. IX, 1909, p. LIX—LXIII).

Zu *Boletus impolitus* Fr., welcher in Schweden, England und namentlich in Zentral-Europa verbreitet ist, stellt Verf. als Varietäten den *B. corsicus* Roll. (syn. *B. sardous* Belli et Sacc.) und *B. tlemcenensis* Maire. Die erstere Varietät kommt in Italien, auf Korsika und Sardinien vor, die letztere in Algier und Portugal.

Maire, R. Some new and interesting British Hymenomycetes gathered at the Baslow fungus foray, 1909 (Transact. British Mycol. Soc. for 1909, vol. III, 1910, p. 169—173, tab. 11).

Enthält Bemerkungen resp. Beschreibungen und Abbildungen zu *Clitocybe ericetorum* (Bull.), *Omphalia Allenii* n. sp., *Hygrophorus Colemannianus* Blox., *H. Reai* n. sp., *Entoloma griseocyaneum* Fr. nov. var. *roseum*, *Leptonia Reaae* n. sp., *Cortinarius praestans* (Cordier), *Russula grisea*, *R. subfoetens* Sm., *Corticium atrovirens* Fr., *Stereum gausapatum* Fr.

Mc Alpine, D. The Smuts of Australia, their structure, life history, treatment, and classification (Melbourne 1910, 8°, 285 pp., tab. I—LVI).

Dem vor vier Jahren veröffentlichten Werke über die Uredineen Australiens folgt nunmehr aus der Feder desselben Autors eine ähnliche monographische Bearbeitung der Ustilagineen dieses in mykologischer Hinsicht noch wenig durchforschten Gebietes. Verf. führt für Australien 68 Arten auf, die sich auf folgende Gattungen verteilen:

Ustilago	18	*Tolyposporium*	7
Melanopsichium	1	*Tilletia*	6
Cintractia	11	*Entyloma*	2
Sorosporium	13	*Urocystis*	7
Thecaphora	2	*Doassansia*	1

Unter diesen Arten befinden sich 13 neue Spezies, von denen *Entyloma Meliloti* auf *Melilotus indica* besonderes Interesse verdient, da dies die erste Art der Gattung ist, welche auf einer Leguminose gefunden wurde.

Dem speziellen Teile, in welchem sämtliche Arten genau beschrieben und von fast allen Arten Habitus- resp. Sporenbilder oder sonstige mikroskopische Details gegeben werden, geht ein ausführlicher allgemeiner Teil voran, der mit besonderer Berücksichtigung der Verhältnisse des Ackerbaues die allgemeinen Verhältnisse in folgenden Abschnitten behandelt: Vegetative Organe — Mycelium, reproduktive Organe — Sporen, deren Entstehung und Keimung, Infektionsverhältnisse, Brandpilze in ihrer Beziehung zu den Rostpilzen, Parasitismus und Immunität, Beziehungen zwischen Wirtspflanze und Parasiten, einheimische und eingeführte Arten, Lebensgeschichte und Behandlung der Getreidebrandpilze (*Tilletia Tritici, T. levis, Ustilago Tritici, Urocystis Tritici, Ustilago Avenae, U. nuda, U. Hordei, Sorosporium Reilianum*), sowie Lebensgeschichte einiger anderer Gräser bewohnender Arten.

Das vorzügliche, von Sachkenntnis und Gründlichkeit zeugende Werk wird sich zweifellos viele Freunde erwerben.

Murrill, W. A. The Polyporaceae of Jamaica (Mycologia vol. II, 1910, p. 183—197).

Verf. führt 102 Polyporeen aus Jamaica auf, unter denen sich 13 neue Arten befinden. Kritische Bemerkungen werden nicht gegeben.

Patouillard, N. et **Demange, V.** Nouvelles contributions à la flore mycologique du Tonkin (Bull. Soc. mycol. France vol. XXVI, 1910, p. 31—48).

Aufzählung einer Anzahl von Pilzen, welche von V. Demange in Tonkin gesammelt wurden, darunter folgende neue Arten:

Cantharellus Bambusae, Androsaceus ficicola, A. omphalinus, Crinipellis bicolor, C. saepiarius, Marasmius pergamenus, M. Hautefeuillei, Calathinus pruinulosus, C. aratus, C. calceolus, Clitopilus orcelloides, Naucoria Musarum, Galera fracticeps, Coprinus miniato-floccosus, Clavaria helicoides.

Neger (Tharandt).

Schwartz, E. J. A new parasitic disease of the Juncaceae (Preliminary notice) (Annals of Botany vol. XXIV, 1910, p. 236).

Die Wurzeln verschiedener *Juncus*-Arten werden von einem Schleimpilz befallen, welcher mit *Sorosphaera Veronicae* nahe verwandt ist (die zytologischen Verhältnisse sind sehr ähnlich) und welcher deshalb *S. Junci* genannt wird. Die Infektion erfolgt durch Eintritt der Myxamöben in Wurzelhaare. Eine Beziehung zu *Entorrhiza* auf *Juncus bufonius* (wahrscheinlich eine Ustilaginee) besteht nicht. Neger (Tharandt).

Seaver, F. J. Notes on North American Hypocreales — III. Two new species with studies of their life histories (Mycologia vol. II, 1910, p. 175—182, 1 fig., tab. XXX).

Enthält die Diagnosen von *Machridella olivacea* n. sp., auf Palmenstielen in Mexiko vorkommend und von *Nectria zonata* n. sp., welche im New Yorker botanischen Garten auf der Außenseite eines Kübels auftrat. Beide Arten haben ein *Verticillium* als Konidienform.

Torrend, C. Première contribution à l'étude des champignons de l'île de Timor (Océanie) (Broteria Ser. Bot. vol. IX, 1910, p. 83—91, tab. II—III).

Die aufgeführten 66 Arten, die zum weitaus größten Teile den Basidiomyceten angehören, wurden vom Missionar Emmanuel Ferreira im portugiesischen Teile der Insel gesammelt. Als neu beschrieben werden *Psalliota fastigiata* und *Pterula timorensis* Torr. Bemerkenswert sind ferner besonders *Armillaria distans* Pat., die bisher nur aus dem Kongogebiet bekannt war, *Boletus Braunii* Bres., ebenfalls bisher nur aus Afrika bekannt geworden, *Poria Pellicula* Jungh., welche zur Gattung *Irpex* gestellt wird und *Stereum Bolleanum* Mont., das bisher nur im Gebiete von Cap Verde gefunden worden war.

Torrend, C. Punctularia tuberculosa Pat. et son état gastérospore, Ceriomyces venulosus (Berk. et C.) Torrend (Bull. Soc. Portugaise Sc. Nat. vol. IV, 1910, p. 9—10).

Verf. entdeckte in Portugal an Eichen- und Olivenzweigen eine Thelephoracee, die sich mit der bisher nur aus Ecuador bekannten *Punctularia tuberculosa* Pat. als identisch erwies. Bemerkenswert ist nun, daß dieser Pilz an feuchten Standorten auch eine zugehörige gasterospore Form entwickelt, die der Gattung *Ceriomyces* entspricht. Diese Form ist bereits unter dem Namen *Reticularia venulosa* B. et C. beschrieben worden, hat aber mit den Myxomyceten natürlich nichts zu tun.

Vouaux, Abbé. Descriptions de quelques espèces de Champignons (Bull. Soc. myc. France vol. XXVI, 1910, p. 153—157).

Folgende neue Arten werden beschrieben:

Trichopeziza Harmandi, *Leptothyrium charticolum*, *Phragmonaevia lignicola*, *Diatrypella Fourcroyae*, *Nummularia oospora*, *Gloniella insularis*, *Gloniopsis xylogramma*, *Hysterographium varians*.

Die meisten derselben wurden in Neu-Caledonien gesammelt.

Neger (Tharandt).

Vuillemin, P. Matériaux pour une classification rationelle des Fungi imperfecti. (Comptes rendus Acad. Sc. Paris vol. CL, 1910, p. 882—884).

Verf. weist darauf hin, daß die zurzeit übliche Einteilung der Fungi imperfecti kein Ausdruck für die Verwandtschaft der Formen ist. Die Konidie, als beständigstes Merkmal, sollte die Grundlage der Einteilung in Hauptgruppen bilden, denen dann die bisher üblichen Einteilungen untergeordnet werden mögen. An Stelle des für die Basidiomyceten zu reservierenden terminus „Basidie" schlägt Verf. den Ausdruck „Phialide" vor. Die Myzelzweige, welche „Phialiden" tragen, wären demnach als „Phialophoren" zu bezeichnen usw. Neger (Tharandt).

Westling, R. En ny askusbildande Penicilliumart (Svensk Botanisk Tidskrift vol. IV, 1910, p. 139—145, 1 fig.).

In Jämtland fand Verf. an Blättern verschiedener Pflanzen gelbe Perithezien von 0,10—0,25 mm Größe, die einer neuen askusbildenden

Penicillium-Art angehören. Die neue Spezies wird als *P. baculatum* bezeichnet und ist mit *P. glaucum* verwandt. Die Konidienform konnte leicht auf Nährmedien gezüchtet werden, doch gelang es dem Verfasser nicht, bei seinen Kulturen auch die Schlauchform zu erzielen.

Griffon et **Maublanc.** Nouvelles recherches sur la pourriture du coeur de la Betterave (Bull. Soc. mycol. France vol. XXVI, 1910, p. 126—131, 1 fig., tab. 1).

Die Verf. weisen mittels Reinkulturen nach, daß die Rübenherzfäule und die häufig gleichzeitig auftretende Blattfleckenkrankheit durch zwei verschiedene Pilze verursacht werden, welche keine genetische Beziehung zueinander haben; erstere durch *Phoma tabifica*, letztere durch ein *Cladosporium*. Neger (Tharandt).

Griffon et **Maublanc.** Le Blanc du chêne et l'Oidium quercinum Thümen (Bulletin Soc. myc. France vol. XXVI, 1910, p. 132—137, 1 fig.).

Eine eingehende vergleichende Untersuchung der Konidien des Eichenmeltaus und anderer in Betracht kommender Oidien legt die Annahme nahe, daß das Eichenoidium, welches seit 1907 in einem großen Teil von Europa epidemisch auftritt, weder mit *Oidium quercinum* Thümen noch auch mit der gleichfalls auf Eiche beobachteten Konidiengeneration von *Microsphaera Alni* identisch ist. Dagegen scheint das *Oidium quercinum* als Konidiengeneration zu *M. Alni* zu gehören. Die Verf. schlagen vor, bis durch Auffindung der Hauptfruchtform die Frage definitiv entschieden werden kann, den Eichenmeltau einstweilen als *Oidium alphitoides* zu bezeichnen. Neger (Tharandt).

Ihssen, G. Fusarium nivale Sorauer, der Erreger der „Schneeschimmelkrankheit" und sein Zusammenhang mit Nectria graminicola Berk. et Br. (Centralbl. f. Bact. etc. II. Abt. vol. XXVII, 1910, p. 48—66, 8 fig., 1 tab.).

Als neu wird zunächst festgestellt, daß die Infektion von Keimpflanzen nur gelegentlich durch den vom *Fusarium*-Myzel durchsetzten Boden stattfinden kann, daß aber in den weitaus meisten Fällen das Saatkorn selbst als Infektionsquelle zu betrachten ist, da sich bei befallenen Roggenkörnern auf der Innenseite der äußeren Samenhaut ein reiches Myzelgeflecht wahrnehmen läßt. Es gelang auch, die Fusariummyzelien zur Bildung von Perithezien zu bringen, die sich mit denen von *Nectria graminicola* als identisch erwiesen. Schnegg (Freising).

Münch, E. u. **Tubeuf, C. v.** Eine neue Nadelkrankheit der Kiefer, Pinus silvestris (Naturwiss. Zeitschr. f. Forst- u. Landwirtschaft vol. VIII, 1910, p. 39—44).

Die Verff. beobachteten schon vor einigen Jahren eine Krankheit der Kiefer, die äußerlich einer Rauchbeschädigung ähnlich sah, trotzdem an der fraglichen Stelle eine solche ausgeschlossen war. Im Laufe der letzten Jahre ist es ihnen wiederholt gelungen, Kiefern unter gleichen Erscheinungen erkrankt zu sehen. Aus den von verschiedenen Standorten stammenden

erkrankten Nadeln wurde einheitlich ein Pilz der Gattung *Hendersonia* reingezüchtet, doch zeigte er mit keiner der bisher bekannten *Hendersonia*-Arten Übereinstimmung. Er wird daher als *Hendersonia acicola* bezeichnet und beschrieben. Schnegg (Freising).

Stäger, Rob. Neue Beobachtungen über das Mutterkorn (Centralbl. f. Bact. etc. II. Abt. vol. XXVII, 1910, p. 67—73).

Entgegen einer früheren Annahme, daß die auf *Poa annua* gefundene *Claviceps* eine biologische Art von *Claviceps purpurea* sei, kommt Verf. durch neue Infektionsversuche zu dem Schluß, daß hier vielmehr eine biologische Art von *Claviceps microcephala* vorliege, für die der Name *Claviceps microcephala* Tul. spec. biologica *Poae* vorgeschlagen wird.

Außerdem wurden als neue Wirte von *Claviceps* gefunden: *Melica ciliata*, *Deschampsia flexuosa*, *Sesleria argentea*, *Festuca nubigena*, *Ataxia Horsfieldii* = *Hierochloa odorata*, *Calamagrostis javanica* und *Spartina stricta*.

Weitere Mitteilungen erstrecken sich auch auf Beobachtungen über die Mithilfe der Insekten bei der *Claviceps*-Infektion in der freien Natur. Schnegg (Freising).

Tubeuf, C. v. Kultur parasitischer Hysteriaceen (Naturw. Zeitschr. f. Forst- u. Landwirtsch. vol. VIII, 1910, p. 408—411).

Kulturversuche von Sporen des Schüttepilzes auf künstlichen Nährböden führten nie weiter als zu steriler Myzelbildung. Nur auf den ganzen oder zerkleinerten Nadeln von *Pinus silvestris* und *P. Strobus* entstanden massenhaft schwarze Pykniden, die stäbchenförmige Sporen in Form von weißlichen Tröpfchen aus ihrer Mündung austreten lassen.

Sie stimmen vollständig mit den früher von Verf. schon gelegentlich der Studien über die Schüttekrankheit abgebildeten überein. Bei wiederholtem Überimpfen des Myzels auf Kiefernadeln entstanden immer wieder reichliche Mengen dieser Pykniden.

Es ist somit bewiesen, daß diese Pykniden, welche sich aus den Askosporenkulturen des Schüttepilzes entwickeln, unzweifelhaft dem *Lophodermium Pinastri* angehören.

Junge Keimpflanzen oder Triebe mit dem Myzel des Pilzes zu infizieren gelang jedoch ebensowenig, wie eine Infektion mit den Askosporen. Schnegg (Freising).

Tubeuf, C. v. Beobachtungen der Überwinterungsart von Pflanzenparasiten (Naturw. Zeitschr. f. Forst- u. Landwirtsch. vol. VIII, 1910, p. 56—58).

Aus den über verschiedene Pflanzenparasiten gemachten Beobachtungen interessieren uns an dieser Stelle namentlich die Beobachtungen bezüglich des Meltaus der Apfelbäume und der *Puccinia Malvacearum*.

Für den genannten Meltau wurden als Überwinterungsort die Knospen erkannt. An überwinterten Apfelbäumen wurden unmittelbar nach der Entfaltung der Knospen die jungen Blättchen mit den weißen, bereits

stäubenden Konidienlagern des Meltaupilzes überzogen aufgefunden, eine Erscheinung, die nur dadurch ihre Erklärung findet, daß der Pilz in der Knospe überwintert und in der noch geschlossenen Knospe fruktifiziert.

Die zweite Beobachtung betrifft die Überwinterung der *Puccinia Malvacearum* an den am Stock bleibenden Blättern von *Althaea rosea*. Die Teleutosporen sind nach dem Schmelzen des Schnees keimfähig.

Eine andere Beobachtung an der gleichen Pflanze läßt darauf schließen, daß das Myzel des Pilzes in den Wurzelstöcken der *Althaea rosea* den Winter überdauert. Schnegg (Freising).

Tubeuf, C. v. Aufklärung der Erscheinung der Fichten-Hexenbesen (Naturw. Zeitschr. f. Forst- u. Landwirtsch. vol. VIII, 1910, p. 349—351).

Verf. kommt durch Aussaat von Samen, die von Fichtenhexenbesen gewonnen wurden, zu dem bedeutungsvollen Resultat, daß die Hexenbesen der Fichte sicher nicht parasitärer Natur sind, dagegen durch Samenaussaat vererbt werden können, da aus einem Teil der Samen Pflanzen mit dem buschigen Wuchs der charakteristischen Fichtenhexenbesen hervorgegangen sind. Schnegg (Freising).

v. Faber, F. C. Zur Infektion und Keimung der Uredosporen von Hemileia vastatrix (Ber. d. Deutsch. Bot. Ges. XXVIII, 1910, p. 138—147).

Durch eine Reihe von Versuchen hat der Verfasser auf Java die Bedingungen für die Keimung und Infektion der Uredosporen des Erregers der gefürchteten Blattkrankheit des Kaffees genau ermittelt.

Die Uredosporen von *Hemileia vastatrix* keimen ebensowohl im Dunkeln als auch bei schwachem Lichte und die Keimung wird durch vorübergehende stärkere Belichtung gefördert. Dagegen wirkt eine länger andauernde stärkere Belichtung schädigend auf die Keimfähigkeit ein. Dabei sind es die stärker brechbaren Strahlen des Spektrums, die die keimungsfördernde Wirkung ausüben. Die Keimung tritt sowohl auf der Oberseite als auch auf der Unterseite der Kaffeeblätter ein, die Infektion erfolgt aber nur durch die ausschließlich auf der Unterseite befindlichen Stomata. Bleiben die keimenden Sporen dauernd in Wasser untergetaucht, so sind die Keimschläuche lang und dünn und wachsen selbst über die Stomata hinweg; eine Infektion unterbleibt also. Wenn dagegen die Wassertröpfchen allmählich eintrocknen, so sind die Keimschläuche kurz und dick, besitzen Appressorien und dringen durch die Spaltöffnungen ein.

Dietel (Zwickau).

Bancroft, C. K. Researches on the life history of parasitic fungi (Annals of Botany vol. XXIV, 1910, p. 359—373, 1 tab.).

Das bekannte *Cladosporium herbarum* tritt in zwei Konidienformen auf: *Hormodendron* und *Cladosporium*.

Hormodendron ist die Sommerform und parasitisch; verursacht im Sommer auf Blättern Fleckenkrankheiten und braucht zur Ausbildung seiner Konidien höhere Temperatur als *Cladosporium*.

Wenn die Blätter absterben, tritt an Stelle der *Hormodendron*-Konidien *Cladosporium* auf. Die Überwinterung erfolgt durch Mikrosklerotien, welche im Frühjahr unter Bildung von *Cladosporium*-Konidien keimen. Später werden wieder *Hormodendron*-Konidien gebildet. Diese entwicklungsgeschichtliche Untersuchung ergibt, daß verschiedene Blattflecken erzeugende *Cladosporium*-ähnliche Pilze zu streichen, bzw. nur als Synonyme aufzufassen sind, z. B. *Dematium Brassicae* u. a. Neger (Tharandt).

Becquerel, P. Recherches expérimentales sur la vie latente des spores des Mucorinées et des Ascomycètes (Comptes rendus Acad. Sc. Paris vol. CL, 1910, p. 1438—1440).

Sporen von verschiedenen Pilzen wurden vollkommen trocken zwei Jahre im Vacuum aufbewahrt, und außerdem drei Wochen einer Temperatur von — 180° und 77 Stunden einer Kälte von — 253° ausgesetzt und verloren doch ihre Keimfähigkeit nicht. Neger (Tharandt).

Coupin, H. Sur la végétation de quelques moisissures dans l'huile (Comptes rendus Acad. Sc. Paris vol. CL, 1910, p. 1192—1193).

Wenn Pilze in Öl sich entwickeln, so findet eine Beeinflussung der aus dem Substrat herauswachsenden Mycelfäden und Fruktifikationen statt. Das dem Luftmyzel entsprechende Myzel bleibt kurz und dürftig. Bei den meisten Pilzen bleibt das Myzel steril (*Mucor, Botrytis, Thamnidium* usw.), nur bei einigen werden Sporenträger ausgebildet (*Penicillium*). Auch die Bildung von Zygosporen (*Mucor*) oder Sklerotien (*Botrytis*) unterbleibt. Neger (Tharandt).

Boulet, Vital. Sur les mycorrhizes endotrophes de quelques arbres fruitiers (Comptes rendus Acad. Sc. Paris vol. CL, 1910, p. 1190—1192).

Der Verf. beobachtete in den Wurzeln vieler Rosaceen ein Pilzmyzel, welches einen großen Teil des Rindengewebes durchzieht und die dort aufgespeicherten Reservestoffe verzehrt. Der Endophyt scheint indessen keine nachteilige Wirkung auf die Wurzel auszuüben, indem er unter normalen Verhältnissen nicht die Überhand gewinnt. Zuweilen aber scheint er doch ernstere Erkrankungen der Wurzeln herbeizuführen. Verf. glaubt die Fälle von unerklärlicher Degeneration von Obstbäumen mit einem Überhandnehmen dieses Wurzelpilzes in Beziehung bringen zu dürfen. Neger (Tharandt).

Schaffnit, E. Coniophora cerebella (Pers.) als Bauholzzerstörer (Centralbl. f. Bact. etc. II. Abt. vol. XXVI, 1910, p. 353—356).

Entgegen den früheren Angaben in der Literatur, nach denen der Pilz nur in feuchten Kellern vorkommen soll, bespricht Verf. drei Fälle, in denen der Pilz auch in den oberen Stockwerken von Häusern beobachtet wurde, namentlich in Räumen, die mit Linoleum belegt waren und als Füllung Kohlenschlacke besaßen. Neben *Coniophora* wurde auch *Paxillus acheruntius* gefunden. In einem anderen Falle war *Coniophora* mit *Ceratostomella* und *Trametes Pini* vergesellschaftet.

Der durch *Coniophora* zerstörte Holzkörper weist die gleichen Erscheinungen auf, wie sie durch *Merulius*, *Polyporus vaporarius* u. a. hervorgerufen werden. Schnegg (Freising).

Geiger, A. Beiträge zur Kenntnis der Sproßpilze ohne Sporenbildung (Centralbl. f. Bact. etc. II. Abt. vol. XXVII, 1910, p. 97—149, 4 fig., 1 tab.).

Verf. bespricht vier zu den Sproßpilzen ohne Sporenbildung gehörige Organismen zunächst in morphologischer Beziehung und beschreibt deren Wachstumserscheinungen in Nährlösungen von verschiedener Zusammensetzung, sowie auf festen Nährböden. Der zweite Teil der Arbeit befaßt sich mit dem chemisch-physiologischen Verhalten der vier Organismen gegenüber Zuckerarten, organischen Säuren und Alkohol und deren Widerstandsfähigkeit gegen Erhitzen in Bierwürze.

Demnach besitzen die Pilze nur ein minimales Gärungsvermögen, doch werden die verschiedenen geprüften Zuckerarten fast alle gut assimiliert. Gegen organische Säuren sind zwei der Pilze sehr empfindlich, während die zwei anderen größere Säuremengen ohne Schaden ertragen, ja sie vermögen sogar einen Teil der Säuren zu assimilieren. Von den Pilzen selbst werden nur sehr geringe Säuremengen gebildet, ebenso auch nur unter bestimmten Bedingungen geringe Mengen Alkohol. Sehr wenig empfindlich sind trotzdem die Organismen gegen Alkohol. Sie vertragen 5 % davon gut, bei 7 % tritt Entwicklungshemmung ein, ohne daß aber ihr Leben zerstört wird. Gegen höhere Temperaturen verhalten sich die Organismen als widerstandsfähig, da sie noch eine Temperatur von $61^1/_2{}^0$ C 5′ lang ertragen können, ohne abgetötet zu werden.

Ihrer systematischen Stellung nach stehen die Organismen der Gattung *Monilia* sehr nahe, weichen jedoch in vielen Beziehungen wieder ab. Es wird daher für dieselben der Name *Pseudomonilia* in Vorschlag gebracht und die Organismen als *Pseudomonilia albomarginata*, *rubescens*, *mesenterica* und *cartilaginosa* bezeichnet. Schnegg (Freising).

Guilliermond, A. Remarques critiques sur différentes publications parues récemment sur la cytologie des levures et quelques observations nouvelles sur la structure de ces champignons (Centralbl. f. Bact. etc. II. Abt. vol. XXVI, 1910, p. 577—589).

Verf. bespricht zunächst kritisch die Arbeiten von Swellengrebel, Fuhrmann, van Hest und Kohl, sowie Wager und Woronichin im Vergleich mit den verschiedenen eigenen Arbeiten und kommt auf Grund neuer Arbeiten zu folgenden Schlüssen:

1. Der Kern der Hefen teilt sich immer während der Sprossung durch Amitose (längs der Einschnürung der Zelle) und nicht durch Karyokinese, wie dies Swellengrebel und Fuhrmann behauptet haben.

2. Der Hefenkern ist aus farblosem Kernhyaloplasma gebildet, umgeben von einer gefärbten Membran. Im Innern des Kernplasmas läßt sich das Vorhandensein einer großen Nukleole und eines mehr oder

weniger deutlichen chromatischen Netzwerks erkennen. Die von Kohl beschriebenen Proteinkristalloide sind identisch mit der Nukleole; auch wurde im Gegensatz zu jenem Autor keine kristallinische Begrenzung beobachtet.

3. Im Gegensatz zu den Anschauungen Kohl's erweisen sich die in den Hefen beobachteten „basophilen Körper" nicht als Kristalloide und scheinen nicht den Cyanophycinkörnern der Cyanophyceen zu entsprechen, noch auch den Protein- oder Aleuronkörnern der höheren Pflanzen. Man beobachtet außerdem in den Vakuolen eingeschlossen Glykogen, auch kleine körnchenförmige Ausscheidungen, die sich mit Eisenhämatoxylin verschieden färben und die aus der Umwandlung der basophilen Körner hervorgegangen zu sein scheinen.

4. Es ist wahrscheinlich, daß die Teilungen, die sich im Askus vor der eigentlichen Sporenbildung abspielen, durch Mitose vor sich gehen. Die von Kohl beschriebenen hantelförmigen Figuren kommen zustande durch die Konzentration des Zytoplasmas um die aus der Teilung des ursprünglichen Kerns hervorgegangenen Tochterkerne und stellen nicht Stadien der Kernteilung dar.

5. Das Epiplasma der Asken enthält eine große Menge von Glykogen, Fett und metathermatische Körper, die die für die Sporenbildung notwendigen Reservestoffe darstellen. Diese verschiedenen Produkte werden von den Sporen während ihrer Reifung teils verbraucht, teils bleiben sie zurück, um gleich bei ihrer Keimung aufgebraucht zu werden.

6. Auf keinen Fall existiert im Epiplasma der von Kohl beschriebene extrasporäre Kern.

7. Bei der Konjugation der Sporen der Hefe Johannisberg II wurde mit Ausnahme der Fälle, in denen eine Kernfusion in der Zygospore sich vollzieht, beobachtet, daß die zwei Kerne vereinigt bleiben und gleichzeitig während der Keimung der Zygospore durch Amitose sich zu teilen scheinen, um sich dann mit den daraus entstandenen Zellen zu vereinigen wie bei der Bildung eines Synkarions. Schnegg (Freising).

Guilliermond, A. Nouvelles observations sur la cytologie des levures (Comptes rendus Acad. Sc. Paris vol. CL, 1910, p. 835—838).

Die vom Verf. früher ausgesprochene Ansicht, daß die Struktur der Hefezelle in nichts von derjenigen anderer Pilze abweicht, ist neuerdings wieder von Wager und Peniston bestritten worden. Die letzteren behaupten, daß die metachromatischen Körperchen auf das Zytoplasma beschränkt seien und nur ausnahmsweise in der Kernvakuole auftreten, sowie, daß das Chromatin in gewissen Stadien in das Zellplasma überdiffundiert. Der Verf. führt nun neues Beobachtungsmaterial an, welches zugunsten der von ihm vertretenen Auffassung spricht. Neger (Tharandt).

Klöcker, Alb. Invertin u. Sporenbildung bei Saccharomyces apiculatus-Formen (Centralbl. f. Bact. etc. II. Abt. vol. XXVI, 1910, p. 513).

Verf. bringt in einer vorläufigen Mitteilung zur Kenntnis, daß er bei einigen Vegetationen, die sonst nur als *Sacch. apiculatus* bestimmt werden können, einen Inhalt von Invertin und zugleich eine Vergärung von Saccharose nach Inversion konstatieren konnte. Ferner ist es ihm gelungen, bei anderen, ebenfalls *Sacch. apiculatus*-ähnlichen Formen endogene Sporenbildung und die Keimung dieser Sporen unter dem Mikroskop zu verfolgen.

Er zieht daraus vorläufig den Schluß, daß sich mehrere Arten unter dem Namen *Saccharomyces apiculatus* verbergen. Schnegg (Freising).

Saito, K. Notizen über einige koreanische Gärungsorganismen (Centralbl. f. Bact. etc. II. Abt. vol. XXVI, 1910, p. 369—374).

Aus zwei Sorten der sog. chinesischen Hefe und vier Sorten der damit bereiteten Maische isolierte Verf.:

In chinesischer Hefe die Schimmelpilze: *Aspergillus Oryzae*, *A. glaucus*, *Monascus purpureus*, *Penicillium glaucum*, *Rhizopus Tritici*, *Rhizopus Tamari*, *Mucor circinelloides*, *Mucor plumbeus* und zwei nicht näher bezeichnete Arten von *Absidia* und *Sachsia*.

Ferner die Hefen: *Sacch. coreanus* n. sp., *Sacch. coreanus* forma *major*, sowie zwei *Mycoderma*-Arten.

In den Maischen wurden außer den beiden neuen Hefearten *Sacch. coreanus* n. sp. und *Sacch. coreanus* forma *major*, die eingehend beschrieben werden, andere Organismen nicht gefunden.

Sacch. coreanus steht in nächster Verwandtschaft zu *Sacch. Marxianus*, unterscheidet sich von ihm aber durch seine Eigenschaft, Inulin nicht zu vergären. Schnegg (Freising).

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(Ausgegeben am 31. Oktober 1910.)